RCRA Facility Investigation-Remedial Investigation/ Corrective Measures Study-Feasibility Study Report for the Rocky Flats Environmental Technology Site Appendix A – Comprehensive Risk Assessment

Volume 15B1 of 15

Aquatic Exposure Units:
Rock Creek Aquatic Exposure Unit
McKay Ditch Aquatic Exposure Unit
No Name Aquatic Exposure Unit
Southeast Aquatic Exposure Unit

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EXECUTIVE SUMMARY

Aquatic Exposure Units (AEUs) represent a logical framework for evaluating risks to populations of aquatic receptors from exposure to surface water and sediment within aquatic systems at the Rocky Flats Environmental Technology Site (RFETS). Seven AEUs were defined through the consultative process with the regulatory agencies (Figure 1.1). This report presents the Ecological Risk Assessment (ERA) for four of the Aquatic AEUs located at RFETS: Rock Creek Drainage AEU (RC AEU), McKay Ditch AEU (MK AEU), No Name Gulch AEU (NN AEU) and Southeast Drainage AEU (SE AEU). The ERA for the other three AEUs (North Walnut Creek AEU [NW AEU], South Walnut Creek AEU [SW AEU], and Woman Creek AEU [WC AEU]) is presented in Volume 15B2.

The RC AEU, MK AEU, and SE AEU are located in buffer zone areas of the site away from where the main industrial activities occurred. The RC AEU is currently a U.S. Fish and Wildlife Service (USFWS) preserve. The NN AEU is downgradient from the former landfill, but was hydrologically separated from the landfill retaining pond. Therefore, these AEUs were expected to have relatively low potential for environmental contamination compared to the AEUs adjacent to the industrial area.

The ERA methods are described in detail in the Final CRA Work Plan and Methodology (DOE 2005), hereafter referred to as the CRA Methodology. The anticipated future land use of RFETS is a wildlife refuge and, consequently, the ephemeral drainages within RFETS represent the aquatic habitat of the refuge. A variety of representative aquatic receptors were evaluated in the ERA, including fish, aquatic invertebrates, and aquatic plants. Waterfowl and wading birds were not directly evaluated as part of this assessment. However, the results and conclusions of the 1996 DOE waterfowl and wading bird evaluation were compared to current conditions in the AEUs to determine the potential for risk.

The overall risk management goal identified for RFETS is that residual contamination should not represent significant risk of adverse ecological effects to receptors. For the AEU aquatic species, the assessment endpoints for this goal included the prevention of adverse effects on populations due to lethal, mutagenic, reproductive, systemic, or general toxic effects associated with site contaminants. These assessment endpoints were evaluated by comparing measured contaminant concentrations in surface water and sediment first to ecological screening levels (ESLs). Sediment ESLs represent media concentrations at which minimal to no effects are predicted. Surface water ESLs are represented by chronic ambient water quality criteria (AWQCs), below which no chronic effects are expected to the aquatic community. Risks were further evaluated using lowest observed effect concentrations (LOECs) for sediment and acute AWQCs for surface water. In addition, potential effects on pond communities were assessed by integrating contaminant exposure results with a spatial analysis to determine whether contaminants represented depositional areas such as ponds in those habitats.

Sampling data for the following media were used for the AEU ERA:

- Surface water;
- Sediment; and
- Surface soil in close proximity to wetted channels or ponds (a potential future source from where contaminants might migrate to the channel or pond).

The ecological contaminants of potential concern (ECOPC) identification process for the ERA examined ecological contaminants of interest (ECOIs) that were present in AEU surface water and sediment through a sequential, multi-step process. For the ECOPC process, data derived from samples gathered since June 28, 1991, to present were relied upon. In addition, sediment samples collected from all depth fractions were evaluated. Surface soil was evaluated as a line of evidence within the risk characterization, and not within the ECOPC selection process.

As the first step in the ECOPC process, the maximum detected concentrations (MDCs) of ECOIs were screened against ESLs. ECOIs without ESLs were considered to be contaminants of uncertain toxicity, and are discussed further in the uncertainty section. A toxicity equivalent (TEQ) concentration using toxicity equivalency factors (TEFs) was calculated for dioxins, and a total PCB and total PAH value per sample was calculated for the ECOPC screen.

The ECOPC selection process continued with the evaluation of contaminants with a detection frequency of less than 5 percent and, subsequently, with concentrations not significantly different from background. Infrequently detected ECOIs and those with concentrations not greater than background were determined to be unlikely to pose sitee-related risk to aquatic receptors. The next step of the ECOPC selection process compared the exposure point concentration (EPC), represented by the 95th upper tolerance limit (UTL) (95th upper confidence limit [UCL] of the 90th percentile), to the ESL. ECOIs were removed from further consideration as an ECOPC if the EPC was less than the ESL. These ECOIs were mapped to determine if ESL exceedances might be spatially grouped in depositional areas such as ponds. No such grouping of elevated concentrations was identified in depositional areas, and all ECOIs with low detection frequencies, or those with EPCs less than the ESL, were removed from further consideration as ECOPCs.

The final ECOPC selection step in the CRA Methodology was a professional judgment evaluation of each remaining ECOI. This step was utilized in RC AEU and SE AEU since both AEUs are located in the buffer zone with no hydrological or physical connection with the IA. It was determined, in these two AEUs, that all ECOIs that passed into this step of the screen were unlikely to be site-related and they are, subsequently, removed from further consideration. No professional judgment was applied for MK AEU or NN AEU due to their proximity adjacent to the IA.

The ECOPC identification results are summarized in Tables ES.1 and ES.2 for surface water and sediment, respectively. The following ECOPCs were carried forward for further evaluation in the risk characterization:

- RC AEU had no ECOPCs in either surface water or sediment.
- Aluminum (total), cadmium (dissolved), iron (total) and zinc (dissolved) in surface water at the MK AEU;
- Aluminum, chromium, fluoride, nickel, selenium and total PAHs in sediment at the MK AEU;
- Ammonia (un-ionized), barium (total), lead (dissolved), selenium (dissolved), silver (dissolved), zinc (dissolved), bis(2-ethylhexyl)phthalate, di-n-butylphthalate, phenanthrene, and phenol in surface water at the NN AEU; and
- Aluminum, barium, iron, lead, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, chrysene, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene and total PAHs NN AEU.
- SE AEU had no ECOPCs in either surface water or sediment.

The risk characterization process involved multiple lines of evidence, each of which evaluated the potential for risk to aquatic receptors from individual ECOPCs and which, together, provided an overall risk conclusion for each ECOPC. Contaminant lines of evidence (LOE) included a hazard quotient (HQ) assessment using the ESLs and LOEC values for sediment and chronic and acute AWQCs for surface water. Some surface water values were refined based on site-specific parameters (e.g., hardness-dependent ambient water quality criterion for divalent metals). The frequency of exceedance was evaluated and the spatial extent of contamination was depicted to determine the extent of ECOPC occurrence within specific aquatic habitats. Further evaluation of refined data sets such as 'post-1999' surface water and surface sediment (0 – 6-inch depth) provided lines of evidence describing current and more realistic exposure conditions. A conservative evaluation of adjacent surface soils was also completed in order to determine the potential future sediment exposure condition. All of the above comprise the various lines of evidence integrated within the chemical risk characterization. Reported values for non-detected samples were also thoroughly evaluated to determine the uncertainty related to each risk conclusion based on chemical LOEs.

A pond-specific evaluation was also conducted in order to understand contaminant risks associated within the East Landfill Pond (within the NN AEU).

The risk characterization continued by reviewing drainage-specific conclusions from previous studies at RFETS. These additional LOE included studies of tissue analyses, aquatic population studies, toxicity bioassays, waterfowl and wading bird exposure studies, and contaminant loading analyses. The specific studies used for this ERA are described in Attachment 7. The combination of findings from the contaminant risk characterization and drainage-specific LOE constitute the weight-of-evidence approach to this ERA.

The approach represents the integrated conclusions from each of the LOEs used in risk characterization. Those basic types of LOEs include contaminant toxicity and exposure information as well as drainage-specific studies on aquatic populations, communities, and habitat characteristics. Overall conclusions are based on best professional judgment using the preponderance of evidence.

Risks are likely to be low based on the results of the risk characterizations for both MK AEU and NN AEU. In both AEUs, sediment ECOPCs are less than LOEC concentrations at all but a small percentage of sampling locations. Risks from fluoride are uncertain in MK AEU. In the one available sample, fluoride had a concentration greater than both the NOEC and the LOEC.

In surface waters, risks were also likely to be low to moderate in both AEUs. Uncertainties were noted in both AEUs based on the availability of recent surface water data, primarily for several metals. In MK AEU, cadmium was identified as an ECOPC with chronic AWQC exceedances but no recent data from which current conditions could be evaluated. In NN AEU selenium, silver and zinc were also detected at concentrations greater than AWQCs in historical data but were lacking current data. The magnitude of exceedances of the chronic AWQCs and the generally small number of exceedances of the acute AWQCs indicate that risks are likely to be low for all ECOPCs in surface water in both AEUs.

The aquatic conditions within the AEUs, evaluated by other studies that are summarized here, indicate that these drainages are primarily limited by flow conditions and habitat. The aquatic life within the system is highly susceptible to changes in flow and, in turn, is represented as an opportunistic assemblage of aquatic invertebrates. No studies have indicated water or sediment quality is a controlling factor to the ecology, and species assemblages are generally comparable to reference areas.

DOE (1996) did not evaluate risks to aquatic feeding birds within the drainages discussed in this Volume, however, the risk assessments performed on the Walnut and Woman Creek drainages provide a tool for determining the potential for risk to wading birds and waterfowl that may utilize the aquatic habitats within the drainages discussed in Volume 15B1.

In all cases, risks are expected to be low to waterfowl and wading birds in RC AEU, MK AEU, NN AEU and SE AEU. ECOPCs identified in previous risk assessments as being of low risk are either not-detected or present at lower concentrations in the AEUs discussed in this volume that those presents as being of low risk in the previous risk assessments on Walnut and Woman Creeks. There is, however, moderate uncertainty in this conclusion since DOE (1996) did not specifically address risks to waterfowl and wading birds in RC AEU, MK AEU, NN AEU or SE AEU. While risks are not expected based on the review of results discussed above, a potential for underestimation of risks exists if there are ECOPCs present in the AEUs discussed in this report that are present at concentrations greater than those evaluated in DOE (1996) for the Walnut and Woman creek drainages.

While significant risks from exposure to ECOPCs in surface water and sediment are not expected, because of uncertainties due to limitations in the data, further monitoring is recommended in order to determine whether ECOPCs with somewhat uncertain current risks are of greater ecological concern than currently indicated by the limited data available. Ecological data suggest that an ecosystem is present in these three AEUs that does not exhibit signs of chemical stress but is primarily limited by habitat quality and hydrology.

1.0 AQUATIC EXPOSURE UNITS

The purpose of this Comprehensive Risk Assessment (CRA) is to identify and evaluate ecological risks posed by organics, metals, and radionuclides remaining at the Rocky Flats Environmental Technology Site (RFETS) following accelerated actions.

The Aquatic Exposure Units (AEUs) represent a framework for evaluating population risks to aquatic receptors from exposure to surface water and sediment within aquatic systems at RFETS. The AEUs established for RFETS are the North Walnut Creek AEU (NW AEU), South Walnut Creek AEU (SW AEU), Woman Creek AEU (WC AEU), No Name Gulch AEU (NN AEU), Rock Creek AEU (RC AEU), McKay Ditch AEU (MK AEU), and the Southeast AEU (SE AEU). This volume, 15B1, presents the Ecological Risk Assessment (ERA) for the RC AEU, MK AEU, NN AEU and SE AEU (Figure 1.1). This introduction encompasses some information for all of the AEUs because an understanding of sitewide features is critical to the CRA process.

This ERA follows the Final CRA Work Plan and Methodology (DOE 2005), hereafter referred to as the CRA Methodology, and encompasses both ecological contaminant of potential concern (ECOPC) selection and risk characterization. These two processes were applied in the same manner for each AEU. In order to streamline presentation of the ERA for each AEU, this report, Volume 15B1, first presents results common to all AEUs, followed by AEU-specific results.

1.1 Aquatic Exposure Unit Description

This section provides a brief description of all the AEUs, including their location at RFETS, historical activities in the area, topography, surface water features, and ecological characteristics. A more detailed description of these features and additional information regarding the geology, hydrology, and soil types at RFETS is included in Section 2.0 of the Resource Conservation and Recovery Act (RCRA) Facility Investigation-Remedial Investigation (RI)/Corrective Measures Study (CMS)-Feasibility Study (FS) Report (hereafter referred to as the RI/FS Report).

The Historical Release Report (HRR) (DOE 1992) and its annual updates provide descriptions of known or suspected releases of hazardous substances that have occurred since the inception of the Rocky Flats Plant. The original HRR organized these known or suspected historical source areas as historical Individual Hazardous Substance Sites (IHSSs), Potential Areas of Concern (PACs), or Under Building Contamination (UBC) sites (hereafter collectively referred to as IHSSs) (Figure 1.2, Table 1.1). Historical IHSSs and groups of historical IHSSs were also designated as Operable Units (OUs). Over the course of cleanup under the 1991 Interagency Agreement (IAG) and the 1996 Rocky Flats Cleanup Agreement (RFCA), the U.S. Department of Energy (DOE) has thoroughly investigated and characterized contamination associated with these historical documented source areas. Historical IHSSs have been dispositioned through appropriate remedial actions or by determining that No Further Accelerated Action (NFAA) is required, pursuant to the applicable IAG and RFCA requirements. Some OUs have also been dispositioned in accordance with an OU-specific Corrective Action Decision/Record of Decision (CAD/ROD). Accelerated actions and other approvals for NFAA were specifically designed to address human health exposures. The intent of the ecological portion of the CRA is to evaluate the residual contamination and the potential for risk to the ecological receptors.

A more detailed description of the OU and IHSS history at RFETS is included in Appendix A, Volume 2 of the RI/FS Report and in Section 1.0, Site Background of the RI/FS Report.

1.1.1 Aquatic Exposure Unit Characteristics and Location

RC AEU

The 735-acre RC AEU is located in the northern and western portion of RFETS (Figure 1.3. The RC AEU is located within the BZ and is outside areas that were used historically for operation of RFETS and it is located generally upwind and hydraulically cross-gradient of the IA. RC AEU is a functionally distinct exposure area encompassing much of the Rock Creek drainage area and containing relatively abundant vegetation, water, and wetland habitat.

The RC AEU is bounded by the RFETS property boundary to the north and west, and by the MK AEU to the south.

MK AEU

The 996-acre MK AEU is located in the northern and central portions of the RFETS (Figure 1.4).: The MK AEU is located within the BZ and is generally outside areas that were used for RFETS operations and it is located generally upwind and hydraulically upgradient of the IA. The MK AEU is a functionally distinct exposure area. It is predominantly a level terrace of the Rocky Flats plain lying between two stream-cut valleys (Rock Creek and Walnut Creek), with sparse vegetation and a relative scarcity of water and wetland habitat.

The MK AEU is bounded by the RC AEU to the northeast, State Highway 128 to the north, Indiana Avenue to the east (the RFETS property boundary), and the NW AEU, SW AEU, NN AEU, and WC AEU as well as the RFETS property boundary to the southwest.

NN AEU

The 302-acre NN AEU is located in the north-central portion of RFETS (Figure 1.5). The NN AEU is located within the Buffer Zone (BZ) just north of the Industrial Area (IA) and encompasses several historical IHSSs, most notably the Present Landfill. Runoff and groundwater at the Present Landfill discharge to the East Landfill Pond, which was historically pumped to the A-series ponds located in the NW AEU.

The NN AEU is bounded on all sides by other AEUs, including the MK AEU to the north and west, and the NW AEU and SW AEU to the south and east, respectively.

<u>SE AEU</u>

The 1,245-acre SE AEU is located in the southern portion of the RFETS (Figure 1.6). The SE AEU is located within the BZ and is outside areas that were used for RFETS operations; it is located south of the IA OU, with the two areas separated by the WC AEU. The SE AEU is generally categorized as being located crosswind and hydraulically cross-gradient relative to the IA.

Most of the surface water flow in the SE AEU is through Smart Ditch, a drainage that includes two small ponds in the far southern section of RFETS. This area receives no runoff from the IA.

The SE AEU is bounded by the RFETS property boundary on the west, east, and south, and by the WC AEU to the north.

1.1.2 Topography and Surface Water Hydrology

This subsection describes the topography and hydrology for the entire RFETS site for all AEUs to provide context for the NW AEU, SW AEU, and WC AEU.

Within RFETS, streams and seeps are largely ephemeral[1] or intermittent[2], with stream reaches gaining or losing flow depending on the season and precipitation amounts.[3] Surface water flow across RFETS is primarily from west to east, with four drainages traversing the site (Figure 1.7):

- Walnut Creek – Major drainage in the north-central portion of RFETS, receiving runoff from the majority of the IA EU. The NW AEU, SW AEU, MK AEU and NN AEU are included in this drainage;
- Woman Creek – Major drainage on the southern side of RFETS, receiving runoff from the southern portion of the IA EU. The WC AEU is included in this drainage;

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[1] An ephemeral stream (defined by the U.S. Army Corps of Engineers) has flowing water only during, and for a short duration after, precipitation events in a typical year. Ephemeral stream beds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from rainfall is the primary source of water for stream flow.
[2] An intermittent stream (defined by the U.S. Army Corps of Engineers) has flowing water during certain times of the year, when groundwater provides water from stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from rainfall is a supplemental source of water for stream flow.
[3] Different stream classifications are defined per the Regulatory Program of the U.S. Army Corps of Engineers, Part 330 – Nationwide Permit Program, Final Notice of Issuance, Re-issuance, and Modification of Nationwide Permits. March 9, 2000 (online: http://www.wetlands.com/COE/NWP3defin.htm).

- Rock Creek – Major drainage in the northwestern part of RFETS that receives no runoff from the IA. The RC AEU is included in this drainage; and

- Smart Ditch – Minor drainage in the extreme southern portion of RFETS that receives no runoff from the IA. The SE AEU is included in this drainage.

Even the largest drainages at RFETS typically have defined channels that are relatively narrow, ranging in bottom width from 2 to 10 feet, often with exposed sediments and cobbles, and occasionally with vegetated channels. Vegetation near the streams is dominated by riparian woodland/shrubland community types, with wet meadow and marsh species near seeps and ponds. A brief description of each of these drainages is provided below. Additional details are provided in Appendix A, Volume 2 of the RI/FS Report and Section 2.0, Physical Characteristics of the RI/FS Report.

Walnut Creek Drainage

The Walnut Creek drainage receives runoff from the majority of the IA as well as the northeastern BZ. The Walnut Creek drainage area is approximately 1,878 acres, which includes the area west of the RFETS boundary. The tributaries to Walnut Creek include, from north to south, McKay Ditch, No Name Gulch, North Walnut Creek, and South Walnut Creek. The stream channel downstream of the confluence between North and South Walnut Creeks is known as Walnut Creek.

McKay Ditch

McKay Ditch runs from west to east across the northern BZ and is hydrologically isolated from the IA. The City of Broomfield can divert water from either Coal Creek or the South Boulder Diversion Canal (both west of RFETS) into the open channel of McKay Ditch across the northern RFETS BZ, into an underground pipeline, and underneath Indiana Street. On the eastern side of Indiana Street, the pipeline daylights and the water flows directly to Great Western Reservoir, where it is stored by the City of Broomfield for irrigation. McKay Ditch is ephemeral and is generally dry. Flows in the ditch historically occur in the spring when the City of Broomfield is able to exercise its water rights and divert water into the ditch, or when overland runoff is captured and transported by the ditch. Future flows in McKay Ditch are expected to be similar to past flows because site accelerated actions do not impact the configuration of the ditch and operations are managed by the City of Broomfield.

No Name Gulch

No Name Gulch is located in the northern BZ downstream from the East Landfill Pond. The East Landfill Pond receives runoff and treated seep water from the Present Landfill area as well as the watershed immediately surrounding the pond, and is hydrologically isolated from the IA. No Name Gulch flow is intermittent, with periodic runoff occurring most frequently in the spring. Closure of the former Present Landfill entailed construction of a Resource Conservation and Recovery Act (RCRA)-compliant cover constructed over the Present Landfill area. This cover is expected to generate a minor increase in localized runoff compared to the historic runoff pattern, though the overall status of No Name

Gulch as an intermittent stream reach, typically flowing in the spring, is not expected to change (DOE 2004).

North Walnut Creek

Stormwater runoff from the northern portion of the IA flows into North Walnut Creek, which has four retention ponds (Ponds A-1, A-2, A-3, and A-4). In contrast to many other site drainages, North Walnut Creek has historically had perennial[4] (e.g., continuous) flow, in areas immediately northeast and downstream from the IA, though flows can be intermittent during extended dry periods. The hydrology of the North Walnut Creek drainage following closure is expected to be very different than in the past. Removal of buildings and pavement from the IA will significantly reduce the volumes and peak discharge rates of runoff.

In North Walnut Creek, intermittent seep flows were historically observed in the location of Functional Channel 1 (the tributary that runs northeast from the northwest portion of the IA OU into North Walnut Creek), in Functional Channel 2 (the tributary that runs northeast from the north central portion of the IA OU into North Walnut Creek), and north of the historical Solar Evaporation Ponds (SEP) area in the northeast quadrant of the IA OU. Functional Channels are those engineered channel reaches that were constructed as part of the site closure configuration activities.

The North Walnut Creek (A-Series) ponds are connected and operated in the following manner:

Ponds A-1 and A-2 are small retention ponds that were historically operated off-line for the purpose of retaining water in the event of a spill or release of hazardous materials into the Walnut Creek drainage basin. Pond A-1 inflow occurs via direct surface water runoff, precipitation and groundwater infiltration. Pond A-2 inflow occurs via infrequent discharges from Pond A-1, surface water runoff, precipitation, and groundwater infiltration. Both remain in an off-line configuration and neither are routinely discharged to Pond A-3 or Pond A-4.

Pond A-3 receives surface water runoff from the northern portion of the IA OU, precipitation, and groundwater infiltration. Volume in Pond A-3 is controlled by periodic discharges to A-4. Pond A-4 receives inflow from Pond A-3, direct surface water runoff, precipitation, and groundwater infiltration. After it has been sampled, Pond A-4 is periodically discharged in batches to flow off the site.

Physical characteristics of the North Walnut Creek ponds were described in the RI/FS (pond volume to spillway elevation) and in DOE 1996 (shoreline length and surface area):

[4] A perennial stream (defined by the U.S. Army Corps of Engineers) has flowing water year-round during a typical year. The water table is located above the stream bed for most of the year. Groundwater is the primary source of water for stream flow. Runoff from rainfall is a supplemental source of water for stream flow.

- A-1 – volume = 5.3 x10^6 L (4.3 ac-ft), shoreline length = 298 m, surface area = 0.37 h
- A-2 – volume = 22.7 x10^6 L (18.4 ac-ft), shoreline length = 420 m, surface area = 0.57 h
- A-3 – volume = 46.7 x10^6 L (37.9 ac-ft), shoreline length = 629 m, surface area = 1.14 h
- A-4 – volume = 121.6 x10^6 L (98.6 ac-ft), shoreline length = 853 m, surface area = 1.09 h

In addition, a small water impoundment, called the "Flume Pond," exists on Walnut Creek just upstream from surface water monitoring location GS03 and approximately 300 feet west of Indiana Street. The surface area of the Flume Pond is estimated to be approximately 0.2 acres. The Flume Pond is not managed; it functions as a flow-through pond.

South Walnut Creek

Runoff from the central portion of the IA flows into South Walnut Creek, which has five retention ponds (Ponds B-1, B-2, B-3, B-4, and B-5). Similar to North Walnut Creek, South Walnut Creek has historically had perennial flow, though flows can be intermittent during extended dry periods. The hydrology of the South Walnut Creek drainage following closure is expected to be different than in the past. Removal of buildings, elimination of water historically imported for RFETS operations, elimination of the Sewage Treatment Plant (STP) discharge, and removal of pavement from the IA will significantly reduce the volumes and peak discharge rates of runoff in this drainage (K-H 2002).

In the South Walnut Creek, intermittent seep flows were historically observed in the location of Functional Channel 4 (by the newly constructed wetlands, west and east of the former Building 991 site), in the drainage north of the Mound treatment system, and on the hillslopes south of Ponds B-1, B-2, and B-5.

The South Walnut Creek (B-Series) ponds are connected and operated in the following manner:

Ponds B-1 and B-2 are small retention ponds that were historically operated off-line for the purpose of retaining water in the event of a spill or release of hazardous materials into the Walnut Creek drainage basin or the STP. Pond B-1 inflow occurs via direct surface water runoff, precipitation and groundwater infiltration. Pond B-2 inflow occurs via infrequent discharges from Pond B-1, surface water runoff, precipitation, and groundwater infiltration. Pond B-3 is also off-line and isolated from South Walnut Creek flows. Pond B-3 was formerly used to detain treated effluent from the RFETS STP. The STP, and its associated discharge, was eliminated during the site decommissioning activities. Ponds B-1, B-2, and B-3 all remain in an off-line configuration and none are routinely discharged to Pond B-4 downstream.

Pond B-4 receives surface water runoff from the central portion of the IA OU. North Walnut Creek flows through Pond B-4 and on to Pond B-5. Pond B-5 receives inflow from Pond B-4, direct surface water runoff, precipitation, and groundwater infiltration. After it has been sampled, Pond B-5 is periodically discharged in batches to flow off the site.

Physical characteristics of the South Walnut Creek ponds were described in the RI/FS (pond volume to spillway elevation) and in DOE 1996 (shoreline length and surface area):

- B-1 – volume = 3.2 x10^6 L (2.6 ac-ft), shoreline length = 159 m, surface area = 0.11 h
- B-2 – volume = 5.6 x10^6 L (4.5 ac-ft), shoreline length =308 m, surface area = 0.31 h
- B-3 – volume =3.6 x10^6 L (2.9 ac-ft), shoreline length = 211 m, surface area = 0.17 h
- B-4 – volume = 7.4 x10^5 L (0.6ac-ft), shoreline length = 172 m, surface area = 0.11 h
- B-5 – volume = 87.6 x10^6 L (71 ac-ft), shoreline length = 616 m, surface area = 0.87 h

<u>Walnut Creek</u>

Downstream from terminal ponds A-4 and B-5, North and South Walnut Creeks merge to form Walnut Creek. The Flume Pond (also referred to as Pond A-5) is a flow-through pond found in this reach of Walnut Creek. As previously noted, the flows in Walnut Creek following site closure will be substantially reduced compared to past flows.

Physical characteristics of the Flume Pond were described in the RI/FS (pond volume to spillway elevation) and in DOE 1996 (shoreline length and surface area):

- A-5 – volume = 6.2 x10^5 L (0.5 ac-ft), shoreline length = 378 m, surface area = 0.144 h

Downstream from RFETS, east of Indiana Street, Walnut Creek flows into a splitter box operated by the City of Broomfield. The splitter box is normally configured to divert flows from Walnut Creek into the Broomfield Diversion Ditch, an open channel that runs around the southern side of Great Western Reservoir. Downstream from the reservoir, the Broomfield Diversion Ditch angles northward before rejoining Walnut Creek. Further east, Walnut Creek flows into Big Dry Creek. The Big Dry Creek drainage basin is an 86-square-mile watershed that is a tributary to the South Platte River. The confluence of Big Dry Creek with the South Platte River is located north of Brighton, Colorado, approximately 30 miles northeast of RFETS.

Woman Creek Drainage

Woman Creek traverses the southern side of RFETS and captures runoff from the southern portion of the IA OU as well as the majority of the southern BZ OU. The on-site portion of the Woman Creek watershed is approximately 3.1 square miles.

The tributaries to Woman Creek include the SID, North Woman Creek, Owl Branch (South Woman Creek), and Antelope Springs Gulch. The stream channel downstream of the confluence between North Woman Creek and the Owl Branch is known as Woman Creek.

South Interceptor Ditch

Runoff from the southern portion of the IA flows into the SID, which was constructed to prevent runoff into Woman Creek. The SID is a grass-lined, trapezoidal channel with ephemeral flow that is routed into Pond C-2. Removal of impervious surfaces (buildings and pavement) from the IA will reduce the historic discharge volumes and peak flow rates. In addition, the western 1,500 feet of the SID were eliminated by the cover for the Original Landfill (IHSS 115). The resulting length of the current SID is approximately 6,000 feet.

Pond C-2 is batch discharged into Woman Creek. Historically, discharge from Pond C-2 was necessary approximately once per year. However, with the reduced runoff from the IA EU flowing into the SID, Pond C-2 discharges to Woman Creek will be even less frequent during normal climatic conditions. Because Pond C-2 discharges were historically a small percentage of the volume measured in Woman Creek, the less frequent discharges should not have a major impact on the overall Woman Creek hydrology.

Owl Branch

The Owl Branch is the tributary that flows intermittently in a northeasterly direction and joins Woman Creek at a location directly south from the location of the former 130 warehouse building. Owl Branch is hydrologically isolated from the IA. Changes to the site resulting from accelerated actions are not expected to alter the watershed or hydrology in the Owl Branch of Woman Creek.

Antelope Springs Gulch

Antelope Springs Gulch conveys water from Antelope Springs, which is a seep on the southern side of Woman Creek that normally flows perennially. The seep is potentially influenced by subsurface flow from Rocky Flats Lake, located offsite to the west (EG&G 1995). Antelope Springs Gulch flows northeast and joins Woman Creek approximately 2,500 feet upstream from Pond C-1. The Antelope Springs drainage is hydrologically isolated from the IAEU. The future hydrology of the Antelope Springs Gulch is expected to be similar to the past because accelerated actions are not impacting the hydrology of this undeveloped watershed.

Woman Creek

The main stem of Woman Creek flows from the west onto the southwest quadrant of the RFETS property and converges with the Owl Branch at a point approximately 1,800 feet east of the RFETS western boundary. The westernmost reach of Woman Creek, upstream from the confluence with Owl Branch, has both perennial and intermittent flow, depending on the specific portion of the channel, and is hydraulically isolated from the IA OU. Accelerated actions are not expected to alter the watershed or hydrology of this portion of Woman Creek. Further downstream, east of the confluence with Owl Branch, Woman Creek is hydraulically connected with the former IA, in terms of groundwater flowing beneath the SID, and discharge from the Original Landfill gravel drain is estimated to yield less than 1 gallon per minute into Woman Creek (see Figure 1.5). Downstream of the confluence between Woman Creek and Owl Branch, Woman Creek traverses the southern side of RFETS and captures runoff from the southern portion of the IA OU as well as the majority of the southern BZ OU. Between the Woman Creek and Owl Branch confluence and Pond C-2, Woman Creek is largely isolated from the IA in terms of surface runoff because the SID intercepts surface flow and diverts it into Pond C-2. However, groundwater from portions of the southern IA discharges into Woman Creek and the flow is intermittent. In the western reach of Woman Creek, the watershed was enlarged when the Original Landfill remediation eliminated the western 1,500 feet of the SID, thereby allowing runoff from the Original Landfill area to flow directly to Woman Creek. However, because the vegetated cover on the Original Landfill will minimize runoff, this change is expected to have a negligible effect on the total flow volume in Woman Creek.

Woman Creek flows through Pond C-1, which was reconfigured as a low-profile, flow-through structure in 2004. Pond C-1 collects water from surface water, groundwater, and precipitation sources. Below Pond C-1 and upstream from Pond C-2, Woman Creek is diverted via a concrete diversion wall and channel called the South Interceptor Ditch (SID) around the northern side of Pond C-2. Below Pond C-2, the diversion channel rejoins the original Woman Creek channel. The SID is a grass-lined, trapezoidal channel with intermittent flow that is routed into Pond C-2.

In Woman Creek, intermittent seep flows were historically observed in several locations north of (uphill from) the South Interceptor Ditch, including west and east of the Original Landfill, south of the Building 881 site, south of the former contractor yard, and a large seep in the 903 Pad Lip Area (southeast of the 903 Pad).

Physical characteristics of the Woman Creek ponds were described in the RI/FS (pond volume to spillway elevation) and in DOE 1996 (shoreline length and surface area):

- C-1 – volume = 2.2 x10^6 L (1.8 ac-ft), shoreline length = 616 m, surface area = 0.87 h
- C-2 – volume = 85.9 x10^6 L (69.6 ac-ft), shoreline length = 266 m, surface area = 0.316 h

Rock Creek Drainage

The Rock Creek drainage covers the northwestern portion of the site's BZ. The watershed area (measured by gaging station GS04) is approximately 1,499 acres and includes an area west of the RFETS boundary. The Rock Creek drainage does not receive runoff from the IA. The drainage basin is characterized by east-sloping alluvial plains to the west, several small ponds within the creek bed, and multiple steep gullies and stream channels to the east. Flow in Rock Creek is intermittent. Within the RFETS boundaries, the hydrology of the Rock Creek drainage is not expected to change as a result of accelerated actions.

The most significant man-made drainage feature in the Rock Creek drainage is the Lindsay Pond, located near the Lindsay Ranch and also referred to as Lindsay Pond 1 (USFWS 2004). The Lindsay Pond was used for stock watering prior to 1974 (USFWS 2001). Two other small, former stock ponds are located upstream from Lindsay Pond 1. Seeps are common in the Rock Creek watershed, particularly on the north-facing hillslopes, and contribute to a range of wetland types in the watershed (USFWS 2001). The 1994 Wetlands Mapping and Resource Study identified a total of approximately 58 acres of wetlands in Rock Creek and its subdrainages (USACE 1994).

The Rock Creek watershed does not receive runoff from the IA and therefore was not included in the model boundaries for the Site-Wide Water Balance study. Contaminant transport pathways from the IA to Rock Creek have not been identified for surface water or groundwater.

Smart Ditch Drainage

In the southern portion of the BZ EU, water from Rocky Flats Lake, located southwest of the site, flows through Smart Ditch before it joins the headwaters of South Woman Creek. South Woman Creek continues flowing west until it reaches a splitter box, which can divert water into one of the following two drainages: 1) South Woman Creek flows west before joining Woman Creek approximately 1,000 feet west of the site boundary. 2) Smart Ditch flows southeast, through two ponds (D-1 and D-2, neither of which are operated by DOE), which are located in the southeastern corner of the BZ OU and are used for irrigation.

South Woman Creek is designated as stream segment 6 in the Big Dry Creek basin by the Colorado WQCC. Both Smart Ditches are owned and operated by the Church Estate, not DOE or its contractors. Neither South Woman Creek, nor either of the Smart Ditches, receive runoff from the IA OU.

Smart Ditch 2 runs northeast of Rocky Flats Lake and is used to flood-irrigate a pasture west of RFETS. Both Smart Ditch and Smart Ditch 2 are typically dry, although each has an estimated flow capacity of 10 cfs. Because the ditch is hydrologically separated and far removed from the IA, limited flow and water quality data has been collected for this conveyance.

1.1.3 Aquatic Life

Aquatic habitats at stream located in and around RFETS have been highly modified over the years by the diversion and impoundment of water. Due to these water management practices, flows in most of these systems are a limiting factor controlling the availability and quality of aquatic habitat. Aquatic habitats of the No Name, McKay Ditch, and Southeast AEUs have not been extensively evaluated, while both spatial and temporal data are available for the Rock Creek AEU. The following discussion presents an overview of aquatic community characteristics in each of these AEUs based on data availability.

Stream communities at RFETS are composed of species that are typical of limited-flow or seasonal-flow environments. Under these conditions, assessment of impacts due to contaminant input is difficult because of natural variability of populations (DOE 1996). The perennial and intermittent stream segments along with seep locations within RFETS are shown in Figure 1.8. Any area identified as having intermittent/perennial flows or standing water was identified as a potential habitat area.

No Name Gulch is an ephemeral system north of North Walnut Creek which is dry throughout much of the year. The East Landfill Pond is upgradient of No Name Gulch, however, the gulch is hydrologically isolated from the pond. Taxa observed in samples collected from this pond included oligochaetes, dipteran larvae, and fingernail clams. A total of 8 different taxa were reported for this location. The number of taxa collected from this pond was within the range of taxa (but on the low end) reported from other RFETS ponds sampled during this investigation (Ebasco 1992). Organisms recovered from this pond are often associated with stressful environments. However, no data have been collected since sediments were removed from the pond during accelerated activities.

The lack of data for aquatic biota from No Name Gulch is likely due to the fact that the stream remains dry for large portions of the year; lack of flow in this stream is the primary factor limiting the development of an aquatic community in the stream.

McKay Ditch has historically been dry and is best characterized as a conveyance ditch. Spring flows and or overland runoff are diverted into McKay Ditch so that the City of Broomfield can exercise its water rights. No aquatic community data have been found for McKay Ditch. The lack of flows in this ditch may explain why no aquatic biota data have been collected from McKay Ditch.

The Southeast AEU is south of Woman Creek and includes Smart Ditch, which conveys most of the flows in this AEU. Smart Ditch is typically dry, although it has an estimated capacity of 10 cfs. Smart Ditch 2 can divert water from Smart Ditch 1 into South

Woman Creek. Smart Ditch 1 carries water released from Rocky Flats Lake to an unnamed natural drainage south of Woman Creek that is nominally tributary to lower Woman Creek. However, this water is continuously diverted to Ponds D-1 and D-2 which are on-site but are privately operated irrigation ponds used exclusively for off-site agricultural purposes. Ebasco (1992) characterized Pond D-1 as usually filled and Pond

D-2 as usually dry. Benthic sampling from 1991 found 6 taxa in Pond D-1. DOE (1996) sampled both Ponds D-1 and D-2 and found 13 and 31 taxa, respectively. These ponds were used as uncontaminated reference ponds in a risk analysis of the A, B, and C series ponds. DOE (1996) indicates that Ponds D-1 and D-2 had a wide range of community characteristics including the second lowest (D-1) and highest (D-2) diversity values. Low richness and high abundance of a single taxon in pond D-1 was indicative of some type of environmental stress. Pond D-1 benthic species were almost completely comprised of aquatic worms (Oligochaeta), while both ponds had high densities of midges (*Diptera, Chironomidae*). Fish sampling in the D series ponds on numerous occasions indicate the presence of fathead minnows.

Rock Creek is best characterized as an intermittent stream fed mainly by numerous groundwater seeps (Ebasco 1992). Groundwater seeps discharging to Rock Creek or its tributaries create many small perennial pools which are critical habitat for aquatic species. Lindsay Pond is the only pond, out of three, that maintains full pool throughout the year. Aquatics Associates (2003) evaluated habitat in Rock Creek in 2001 and 2002. This study found that while flows were permanent at two stations on the North Fork of the Middle Fork of Rock Creek, flows are low and diminish at the downstream sampling stations located (1) downstream of Lindsay Pond, and (2) upstream of the North and South Fork confluence. At these lower stations, permanent pools exist, but mainstream channel flows are intermittent. The lack of water during summer months is the primary limiting factor affecting habitat quality and adversely affects the establishment of fish and macroinvertebrate populations in Rock Creek (Aquatics Associates 2003).

The most common aquatic macroinvertebrates (aquatic insects) found at Rock Creek sites were the blackfly (*Diptera, Simulidae*.), midge (*Diptera, Chironomidae*), aquatic worms (Oligochaeta, Tubificidae), and scuds (Amphipoda, Hyallela). Other abundant species include mayfly (*Ephemeroptera*), stonefly (*Plecoptera*), and snails (*Gastropoda*).

Fathead minnows (*Pimephales promelas*) are a native species found in Lindsay Pond and upper segments of Rock Creek. Largemouth bass (*Micropterus*) and white suckers (*Catostomus commersoni*)were also found in Lindsay Pond.

More specific discussions are provided in Attachment 7.

1.1.4 Site Conceptual Model

A site conceptual model (SCM) is presented in the CRA Methodology and described in detail in Appendix A, Volume 2 of the RI/FS Report. The SCM presents the pathways of potential exposure from documented historical source areas (IHSSs and PACs) to the receptors of concern. A summary of the SCM components as they pertain to the AEUs is described below.

For the purposes of this evaluation, the targeted receptor representative of the ecological functional group most appropriate for the watershed ERAs is general aquatic life, which includes fish, amphibians, and benthic macroinvertebrates. Wading birds and waterfowl were also considered important receptors, however an assessment of site-related risk within the Walnut and Woman Creek drainages had been previously completed by DOE (1996). The results are revisited within this document as a line of evidence to evaluate overall risks to receptors within the four AEUs. While DOE (1996) did not directly assess risks to wading birds and waterfowl within the drainages discussed in this document, it does provide a tool for comparison of conditions observed in the Walnut and Woman Creek drainages and the conclusions reached based on those conditions with the conditions found in the AEUs discussed in this Volume. Details regarding the methods (i.e. ingestion rates, exposure and area use assumptions) can be found within the DOE 1996 document and are summarized in Attachment 7.

For the purposes of this evaluation, the endpoints for this assessment are the following:

- Assessment Endpoint – Survival, growth, and reproduction adequate to sustain populations at RFETS within the AEU; and

- Measurement Endpoints – Comparison of concentrations of contaminants in environmental media (surface water and sediment) to toxicity reference values (TRVs).

Aquatic receptors can be exposed to contaminants directly through contact with contaminated media (surface water and sediment) or indirectly through consumption of organisms that have been exposed to (and bioaccumulated) contaminants. For purposes of the CRA, surface water and sediment were considered to be the media providing the greatest contaminant exposure to aquatic organisms. For waterfowl and wading birds, the ingestion of tissues that have potentially bioaccumulated ECOPCs and the ingestion of surface water and sediment were the exposure pathways of most importance in the watershed risk assessment (DOE 1996).

Soils in the immediate vicinity of the wetted channels and pond edges were also evaluated as part of this CRA. Adjacent soil was defined as soil within 20 feet of the wetted edge of a given AEU feature such as a stream channel, pond, or seep. Because these soils could erode or transport to a receiving drainage as a result of overland flows, they may represent potential future sediment that would act as a source of exposure to future aquatic life receptors.

The magnitude of exposure to environmental contaminants depends not only on concentration but also frequency and duration of contact. In the case of sediment, concentrations of contaminants are likely static (although varying with depth in the sediment). Concentrations in surface water may change seasonally and particularly in response to precipitation and snowmelt events or other factors affecting flows and associated contaminant transport. The dominant factor controlling the exposure of aquatic receptors is their behavior and overlap, both spatially and temporally. Daily, weekly, and seasonal use patterns and dietary habits determine the amount of time an organism is in contact with contaminated media and the extent of exposure. In the case of the AEUs, the limited flows often affect aquatic organism distribution, abundance, and behavior. Some aquatic invertebrate communities are adapted to episodic flow conditions, as is typical for these AEUs. Species of fish, however, are less capable of such adjustment and, therefore, are unlikely to occur in areas that do not have sustained flows except through seasonal migrations from permanently wetted areas.

1.1.5 Data Description

Data have been collected at RFETS by implementation of regulatory agency-approved Work Plans, Sampling and Analysis Plans (SAPs), and Quality Assurance Project Plans (QAPjPs) to meet data quality objectives (DQOs) and appropriate U.S. Environmental Protection Agency (EPA) and Colorado Department of Public Health and Environment (CDPHE) guidance. Surface water and sediment samples were collected from the AEUs (Table 1.2). The sampling locations for these media are shown on Figures 1.9 through 1.12, and data summaries for detected analytes in each medium are provided in Tables 1.3 through 1.10. Figures 1.9 through 1.12 show all sample locations but data are not necessarily available for all analytes at each location. For ecological contaminants of interest (ECOIs) that were analyzed for but not detected or detected in less than 5 percent of the samples, detection limits are compared to ecological screening levels (ESLs) in Attachment 1. A detailed description of data storage and processing methods is provided in Appendix A, Volume 2 of the RI/FS Report. The complete data set for the AEUs is provided in Attachment 4 on a compact disc (CD).

In accordance with the CRA Methodology, only data collected on or after June 28, 1991, are used in the CRA. Surface water samples for both total and dissolved fractions were collected.

The sampling data available for the assessment of the AEUs are used as follows:

- Surface water data (filtered and unfiltered samples);
- Sediment data (all data regardless of depth)

The sample results from all samples collected for surface water and sediment since June 28, 1991 were evaluated within the ECOPC Identification process. Surface water samples collected using one-time grab sampling techniques and using sampling techniques to collect multiple samples from the same location over time were included in the surface water dataset.

Other data subsets used in the Risk Characterization as other lines of evidence include:

- Surface water collected after 12/31/1999 (subset of complete surface water data set described above)
- Surface sediment (0 – 6"; subset of complete sediment data set described above)
- Surface soil (0 – 6") data within 20 feet of the wetted areas (discussed as potential future sediment exposure).

The following describes the data summary by AEU for the data sets used within the ECOPC identification process.

RC AEU

Surface Water

The surface water data set consists of up to 110 samples for various analyte groups (Table 1.2). Surface water samples were collected from 15 locations (including six designated background locations) in the RC AEU (Figure 1.9) between July, 1991, and August, 2005. The samples were analyzed for inorganics (110 total and 42 dissolved samples), organics (43 total samples), and radionuclides (43 total and 5 dissolved samples) (Table 1.2). The data summary for surface water is presented in Table 1.3. Constituents from all three analyte groups were detected.

Sediment

The sediment data set for RC AEU consists of up to 22 samples for various analyte groups (Table 1.2). The sediment data set includes data from eight shallow sediment sampling locations shown on Figure 1.9. The sediment samples were collected from depths less than 0.5 ft from the sediment surface. The samples were collected between 1991 and 1993, as well as in 2004, and were analyzed for inorganics, organics, and radionuclides (20 samples).

MK AEU

Surface Water

The surface water data set for MK AEU consists of up to 40 samples for various analyte groups. The samples were collected in the MK AEU over several months from July, 1991, through July, 1996, and again in December, 2004, through January, 2005. Sample locations are shown on Figure 1.10.

The MK AEU surface water samples were analyzed for inorganics (up to 40 total and 27 dissolved samples), organics (up to 14 total samples), and radionuclides (up to 38 total samples and 1 dissolved sample) (Table 1.2). Detected analytes included inorganics and radionuclides as well as several organics (Table 1.5). A summary of analytes that were not detected in surface water in the MK AEU is presented and discussed in Attachment 1.

Sediment

The sediment data set for MK AEU consists of up to 13 samples for various analyte groups collected from depths less than 0.5 foot from the sediment surface. The samples were collected in the MK AEU over several months from August, 1991, through March, 1995, and again in December, 2004. Sample locations are shown on Figure 1.10.

Adjacent surface soils were also evaluated as potential future sediments. The MK AEU sediment samples were analyzed for inorganics (up to 12 samples), organics (up to 8 samples), and radionuclides (up to 13 samples) (Table 1.2). Detected analytes included inorganics, organics, and radionuclides (Table 1.6). A summary of analytes that were not detected in sediment in the MK AEU is presented and discussed in Attachment 1.

NN AEU

Surface Water

The surface water data set for the NN AEU consists of up to 74 samples for various analyte groups. The samples were collected in the NN AEU over several months from July, 1991, through August, 2005. Sample locations are shown on Figure 1.11. The NN AEU surface water samples were analyzed for inorganics (up to 73 total and 32 dissolved samples), organics (up to 60 total samples), and radionuclides (up to 74 total and 14 dissolved samples) (Table 1.2). Detected analytes included inorganics, organics, and radionuclides (Table 1.7). A summary of analytes that were not detected in surface water in the NN AEU is presented and discussed in Attachment 1.

Sediment

The sediment data set for NN AEU consists of up to 23 samples for various analyte groups collected from depths less than 0.5 foot from the sediment surface. The samples were collected in the NN AEU over several months from August, 1991, through October, 1994, and again in August, 1997, and October, 2000. Sample locations are shown on Figure 1.11. Adjacent surface soils were also evaluated as potential future sediments.

The NN AEU sediment samples were analyzed for inorganics (up to 20 samples), organics (up to 16 samples), and radionuclides (up to 23 samples) (Table 1.2). Detected analytes included inorganics, organics, and radionuclides (Table 1.7). A summary of analytes that were not detected in sediment in the NN AEU is presented and discussed in Attachment 1.

SE AEU

Surface Water

The surface water data set for SE AEU consists of up to 14 samples for various analyte groups. The samples were collected in the SE AEU over several months from August 1991 through March, 1993, and again in December, 2004, through January, 2005. Sample locations are shown on Figure 1.12.

The SE AEU surface water samples were analyzed for inorganics (up to 14 total and 7 dissolved samples), organics (up to 7 total samples), and radionuclides (up to 11 total and 2 dissolved samples) (Table 1.2). Detected analytes included inorganics and radionuclides. Methylene chloride was the only organic detected in the SE AEU surface water (Table 1.9). A summary of analytes that were not detected in surface water in the SE AEU is presented and discussed in Attachment 1.

Sediment

The sediment data set for SE AEU consists of up to nine samples for various analyte groups collected from depths less than 0.5 foot from the sediment surface. The samples were collected in the SE AEU in October, 2000, and again in December, 2004 through

January, 2005. Sample locations are shown on Figure 1.12. Adjacent surface soils were also evaluated as potential future sediments.

The SE AEU sediment samples were analyzed for inorganics (up to seven samples) and radionuclides (up to nine samples) (Table 1.2). Detected analytes included inorganics and radionuclides; no organics were analyzed in the SE AEU (Table 1.10). A summary of analytes that were not detected in sediment in the SE AEU is presented and discussed in Attachment 1.

1.2 Data Adequacy

A data adequacy assessment was performed to determine whether the available data set discussed in the previous section is adequate for risk assessment purposes. The data adequacy assessment rules are presented in the CRA Methodology, and a detailed data adequacy assessment for the data used in the CRA is presented in Appendix A, Volume 2, Attachment 3 of the RI/FS Report. The adequacy of the data was assessed by comparing the number of samples for each analyte group in each medium as well as the spatial and temporal distributions of the data to data adequacy guidelines. If the data do not meet the guidelines, other lines of evidence (e.g., information on potential historical sources of contamination, migration pathways, and the concentration levels in the media) are examined to determine if it is possible to make risk management decisions given the data limitations.

The findings from the data adequacy assessment applicable to all AEUs are as follows:

- For herbicides and pesticides, although the existing sediment data may not meet the minimal data adequacy guidelines for each AEU, there is considerable site-wide data, and pesticides and herbicides are infrequently detected across RFETS at low concentrations, generally below ESLs. This line of evidence indicates that it is possible to make risk management decisions without additional sampling for these analyte groups.

- For dioxins, although the existing sediment data do not meet the minimal data adequacy guidelines for each AEU, sediment samples were collected in targeted ponds where dioxin contamination may have migrated via runoff from historical IHSSs in and near the former Industrial Area where dioxins may have been released based on process knowledge. Results indicated that dioxin concentrations are not above the minimum ESL in sediment and dioxins are not detected in surface water. Therefore, although the existing data do not meet the minimal data adequacy guidelines for each AEU, it is possible to make risk management decisions without additional sampling. However, unlike pesticides and herbicides where there is considerably more site-wide data, there is greater uncertainty in the overall risk estimates because fewer samples were collected at the site for dioxins.

The findings from the data adequacy report applicable to the NN AEU, RC AEU, MK AEU, and SE AEU are as follows:

- The surface water and sediment data for radionuclides and metals for each AEU exceed the data adequacy guideline for number of samples. For surface water, the data adequacy guideline for the number of samples for VOCs, SVOCs, and PCBs is met for the NN AEU, the RC AEU (except PCBs), the MK AEU (except SVOCs and PCBs), and the SE AEU (excpt SVOCs and PCBs). For sediment, the data adequacy guideline for the number of samples for VOCs, SVOCs, and PCBs is met for the NN AEU, the RC AEU, and the MK AEU. It is not met for any of these organic analyte groups for the SE AEU. However, in the RC AEU and SE AEU, PAC 000-501 (Roadway Spray Areas) is the only historical IHSS, and in the MK AEU, PAC 000-501 is the only historical IHSS where process knowledge indicates a potential for organic contamination. PAC 000-501 are roads that were sprayed with waste oil for dust control, and accordingly, the oil could have contained polynuclear aromatic hydrocarbons (PAHs) but not PCBs.[5] In addition, the data for surface soil samples collected near the road indicate that PAHs (and PCBs) are not detected. Furthermore, all of these AEUs are hydraulically separated from and generally upwind/crosswind of potential historical source areas in and near the former Industrial Area. Therefore, although the existing organics data do not meet the minimal data adequacy guidelines for the AEUs, available information on potential historical sources of contamination in the AEUs, contaminant migration pathways from potential sources in other AEUs, and concentration levels in surface soil show that organic constituents are not likely to be present in surface water or sediment for these AEUs, and it is possible to make risk management decisions without additional sampling.

- Surface water samples were collected for dioxin analysis from the influent to the East Landfill Pond (NN AEU) and from Pond D-1 (SE AEU). Dioxins were not detected. Surface water samples in the MK AEU and the RC AEU, as well as sediment samples in the NN AEU, RC AEU, MK AEU, and SE AEU were not collected for dioxin analysis. Although this does not meet the minimal data adequacy guideline, as noted above, it is possible to make risk management decisions without additional sampling.

- Surface water and sediment sampling locations for all analytes are generally well distributed throughout the RC AEU, MK AEU, and SE AEU, and therefore, the data meet the data adequacy guideline for spatial representativeness. In the NN AEU, sample locations are primarily clustered in and just downstream (east) of the East Landfill Pond, which receives runoff from the upstream IHSSs. Therefore, although the existing NN AEU data do not meet the data adequacy guideline for spatial representativeness, the sampling locations for all analytes are

[5] Based on the summary presented for PAC 000-501 in the 2005 Annual Update to the Historical Release Report (DOE 2005a), the sources of oil for roadway spraying in the RC AEU, MK AEU, and SE AEU would be one or both of the following: in October 1982, 120 liters of Number 2 diesel fuel from a tank spill on the northern side of Building 371 was used on roads; and in September 1983, 1,200 gallons of Mobil Number 634 gear lubrication oil from a Building 883 rolling mill lube system was used on Plant gravel roads. These oils are not expected to contain PCBs.

in areas that are expected to contain the highest levels of contamination, and therefore, EPC calculations for the NN AEU will be conservative. Accordingly, it is possible to make risk management decisions without additional sampling.

- For the NN AEU and RC AEU surface water and sediment, except for PCBs, the data are for samples collected in the current time frame (e.g., 2001 or later), and thus meet the guideline for temporal representativeness. PCBs were not detected in samples collected prior to 2001 for both the NN AEU and RC AEU. Although there are no recent PCB data, for the RC AEU, there are no sources for PCB contamination, and therefore, concentration trends for PCBs are unlikely, and it is possible to make risk management decisions without additional sampling. For the NN AEU, as summarized below and as discussed in Appendix A, Volume 15B1, Attachment 1 of the RI/FS report, detection limits were frequently above the ESL, and professional judgment suggests PCB-1254 and PCB-1260 have the potential to be ECOPCs in the NN AEU sediment and surface water had detection limits been lower. Therefore, there is some uncertainty with respect to the adequacy of the PCB sediment and surface water data. For the MK AEU and SE AEU surface water and sediment, there are no current VOC, SVOC, or PCB data. However, as discussed above, the historical IHSSs in these AEUs are not expected to be sources for organic contamination based on process knowledge and surface soil data, and these AEUs generally isolated from sources of contamination in the former IA. Therefore, organic analytes are not expected to be present in surface water and sediment in these AEUs, and it is possible to make risk management decisions without additional sampling.

- As discussed in Attachment 1, for analytes not detected or detected in less than 5% of the samples in surface water and sediment, there are many analytes whose detection limits exceed the ESLs, and in some cases, the upper end of the detection limit ranges significantly exceed the ESLs. However, the higher detection limits for most of these analytes contribute only minimal uncertainty to the overall risk estimates because either only a small fraction of the detection limits are greater than the chronic ESL for surface water or the No Observed Effect Concentration (NOEC) ESL for sediment, or professional judgment indicates they are not likely to be present in the AEU surface water and sediment. However, professional judgment indicates that some of these analytes have potential to be ECOPCs in the AEU surface water and sediment based on professional judgment, and therefore, there is uncertainty in the overall risk estimates because of their higher detection limits, i.e., overall risks to the AEU aquatic populations may be underestimated because these analytes may have been included as ECOPCs for surface water and sediment had the analytes been detected at higher detection frequencies using lower detection limits. These analytes are as follows:

    - Surface water: cadmium (dissolved), cadmium (total), 4,4'-DDT, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzoic acid, heptachlor epoxide, PCB-1254, PCB-1260, pentachlorophenol, and pyrene in the NN AEU; silver (dissolved), silver (total), benzo(a)anthracene, benzo(a)pyrene, benzoic acid, di-n-butylphthalate, pentachlorophenol, phenanthrene, and pyrene in the RC AEU; cadmium (dissolved), cadmium (total), di-n-butylphthalate, phenanthrene, and pyrene in the MK AEU; and cadmium (dissolved) and cadmium (total) in the SE AEU. All of these analytes would present a potential for chronic ecological effects, and some of these analytes would present a potential for acute ecological effects if they were detected at the maximum detection limits, i.e., the maximum detection limits exceed the chronic ESL, and in some cases, the acute effects levels.

- Sediment: 2-methylnaphthalene, 4,4'-DDT, acenaphthene, acenaphthylene, dibenz(a,h)anthracene, dibenzofuran, diethylphthalate, fluorene, heptachlor epoxide, PCB-1254, PCB-1260, and pentachlorophenol in the NN AEU. In the RC AEU and MK AEU, analytes in sediment that have reported results that exceed the ESLs contribute only minimal uncertainty to the overall risk estimates because professional judgment indicates they are not likely to have been ECOPCs even if detection limits (reported results) had been lower. For the SE AEU, none of the analytes in sediment have detection limits that exceed the ESL In addition, for the analytes that have potential to be ECOPCs in the NN AEU sediment based on professional judgment, some of these analytes would present a potential for adverse ecological effects if they were detected at their maximum detection limits, i.e., the maximum detection limits exceed the Lowest Observed Effect Concentrations (LOECs).

1.3 Data Quality Assessment

A Data Quality Assessment (DQA) of the AEU data sets was conducted to determine whether the data were of sufficient quality for risk assessment use. The AEU-specific DQA is presented in Attachment 2 of this volume, and an evaluation of the entire RFETS data set is presented in Appendix A, Volume 2 of the RI/FS Report. It was concluded that the data are of sufficient quality for use in this CRA. Attachment 2 contains the complete evaluation of data quality.

2.0 IDENTIFICATION OF ECOLOGICAL CONTAMINANTS OF POTENTIAL CONCERN

The ECOPC identification process streamlines the ecological risk characterization by focusing the assessment on ECOIs that are present in surface water and sediment media from each AEU. This process is based on the SCM presented in the CRA Methodology (DOE 2005) and described in detail in Appendix A, Volume 2 of the RI/FS Report. Generally, as described in Section 1.1.5, the most significant exposure pathway to aquatic life receptors is through the direct contact of potentially contaminated surface water and sediment. The most significant exposure pathway for waterfowl and wading birds is the ingestion of food items that may have bioaccumulated ECOPCs.

2.1 Data Used in the Ecological Risk Assessment

Surface water and sediment media were evaluated for the AEU ERAs. As discussed in Section 1.1.5, data used for the AEU ECOPC evaluations represent the AEU data set gathered since June 28, 1991 with post-accelerated action confirmation sample results incorporated as well as the additional pond sampling results gathered July, 2005.

The ECOPC identification process relied on the entire surface water and sediment database. Surface water data were not limited to a recent temporal period and sediment data from the entire sediment column were utilized as a conservative means for selecting ECOPCs.

Ecological screening levels (ESLs) for inorganic contaminants are based on either dissolved or total metal fractions depending on the underlying toxicological data for the ESL. The fraction appropriate for comparison to the ESL was used for the ECOPC process. For instance, many divalent metals have ESLs for the dissolved fraction (e.g., cadmium, copper, chromium, lead, mercury, nickel, silver, and zinc), while the remaining inorganics have ESLs for the total fraction. Ammonia presents a unique contaminant for which the ESL is based on the “un-ionized” fraction. Only the total aqueous ammonia fraction was measured, and not the un-ionized fraction; therefore, the un-ionized fraction was calculated from the total aqueous measurement using a temperature and pH dependant conversion factor developed for each AEU (EPA 1985). This calculation method is discussed in Attachment 5. The calculated un-ionized concentrations are shown within the ECOPC summary tables and spatial distribution figures.

Other data sets were relied upon, following ECOPC identification, as additional lines of evidence in each AEU risk characterization included post-1999 surface water and surface sediment (0-6”) which are subsets of the complete surface water and sediment data sets, respectively, and adjacent surface soils (within 20’ of the wetted perimeter of the water body). These other data sets were reviewed as part of the lines of evidence describing chemical risk characterization.

ESLs for inorganic and organic contaminants were compared to the detected sample results. Groups polycyclic aromatic hydrocarbons (PAHs) tend to act additively because of similar modes of toxic action. To account for this interactive toxicity a total concentration was calculated for PAHss within each sample. The total PAH concentrations were determined in a stepwise manner:

1. A standard list of 16 PAHs was compiled.
2. A total PAH value was determined for each sample, using detected concentrations and ½ of the reported value for nondetected PAHs.
3. The total PAH value was compared to the “total PAH” ESL for the ECOPC identification process.
4. To identify the most relevant exposure to the assessment endpoints, the total PAH value in surface sediment was compared to the ESL for the chemical risk estimation.

Details of the total PAH calculations are provided in Attachment 5. PCBs were not detected in surface water or sediments in any of the AEUs discussed in this document. Therefore, calculation of total PCBs are not required. A discussion of non-detected PCBs is provided in Attachment 1. Additionally, dioxin data were available in NN AEU and SE AEU but dioxins were never detected. Summation of total dioxin concentrations are, therefore, not required in these AEUs. A discussion of non-detected dioxins is provided in Attachment 1.

Surface water and sediment from RC AEU, MK AEU, NN AEU, and SE AEU included samples from locations considered part of the background data set for RFETS. These background samples were included in the AEU data evaluated in the initial steps of ECOPC identification. Background samples were then removed from the AEU data set for the statistical comparison of site sample concentrations to background concentrations, and in professional judgment evaluations.

2.2 Identification of Surface Water and Sediment ECOPCs

ECOPCs for surface water and sediment were identified for aquatic receptors in accordance with the sequence presented in the CRA Methodology. The ECOPC identification process for the ERA examined ECOIs that were present in AEU surface water and sediment through a sequential, multi-step process. All ECOIs, including essential nutrients, which were not included in the CRA Methodology but were included here for purposes of completeness and conservatism, were evaluated using the following process:

The first step of the ECOPC selection process is a comparison of ECOI maximum detected concentrations (MDCs) in surface water and sediment to their respective ESLs. Those ECOIs for which ESLs are not available are removed from further consideration within the ECOPC process, and are discussed further as ECOIs with uncertain toxicity (Section 6.0). A list of ECOIs with uncertain toxicity is summarized in Section 6 for each AEU. Contaminants where the MDCs are greater than the ESL are retained for further analysis in the ECOPC selection process. ESLs are presented in the CRA Methodology based on the most significant exposure pathways and receptors presented in the SCM, and represent concentrations that are predicted to result in either no-adverse effects or minimal or threshold effects to aquatic receptor populations.

A detection frequency screen is performed for those ECOIs that are not eliminated in the MDC-ESL screen to identify ECOIs with less than a 5 percent detection frequency. Infrequently detected ECOIs are not expected to pose a potential for risk to aquatic receptors. However, ECOIs with less than 5 percent detection are mapped for additional spatial evaluations. The mapping is completed in order to determine if the few detected concentrations of these ECOIs occur in depositional areas (such as ponds) that could pose a potential risk to aquatic populations areas. In addition, the reported values for non-detected samples were also reviewed for these chemicals to determine if detection limits were adequate to allow for removal of these ECOIs from consideration as ECOPCs in this step of the ECOPC identification process.

Statistical comparisons against the appropriate background data set are performed for each inorganic ECOI that is not eliminated in the detection frequency screen in accordance with the CRA Methodology. The background analyses utilize two statistical programs: ProUCL (Version 3.0) and S-Plus. The statistical methods used are described in Attachment 3 as well as in Appendix A, Volume 2 of the RI/FS Report. ProUCL is used to determine the data distributions of the AEU and background data sets. The data distribution types determine the appropriate statistical test for the background comparison. S-Plus is then used to compare the two data sets. Those contaminants found to be statistically greater than background are retained for further analysis in the ECOPC selection process. All other inorganic ECOIs are eliminated from the ECOPC selection process as prescribed in the CRA Methodology. Background comparisons were not performed for organic ECOIs.

For those ECOIs retained in the ECOPC selection process, the exposure point concentration (EPC), a conservative measure of upper-bound concentrations represented by the 95th upper tolerance limit (UTL) (95th upper confidence limit [UCL] of the 90th percentile), is compared to the ESL. The upper-bound EPC is a conservative measure of potential exposure for organisms with low mobility. Calculation of this statistic uses one-half of the reported value as a proxy value for nondetected concentrations. Where sufficient data are unavailable (e.g., N < 5) to calculate statistical parameters or where the UTL exceeds the MDC, the MDC is used as the default EPC. This EPC is compared to the CRA Methodology ESL that is representative of a no observable effects concentration (NOEC) or threshold effects concentration. ECOIs with UTLs less than their ESLs are removed from further consideration within the ECOPC process. The ECOIs screened out in this step are mapped to evaluate spatial extent and to evaluate their potential for posing a risk in important habitat areas (i.e. ponds). Those ECOIs that do not present a depositional pattern within ponds and have EPCs less than the ESLs are removed from consideration as ECOPCs.

The final ECOPC selection step as per the CRA Methodology is a professional judgment evaluation of each of the remaining ECOIs. This evaluation considered the potential for contaminant sources, frequency of detected concentrations greater than the ESL, spatial and temporal analysis of each ECOPC to determine a potential for risk based on best professional judgment (Attachment 3).

A more detailed discussion of the ECOPC screening procedure and the assumptions inherent in this procedure are provided in Section 7.3 of the CRA Methodology and in Appendix A, Volume 2 of the RI/FS Report.

2.3 Summary of ECOPCs for AEUs

ECOPCs for surface water and sediment were identified for aquatic receptors in accordance with the screening process presented in the CRA Methodology (DOE 2005). The following subsections present the outcome of the ECOPC process for each AEU. Special consideration was given in each step of the process for ECOIs that are eliminated in order to evaluate their potential to be present in isolated depositional areas which may occur within pond areas that provide unique habitat settings.

A summary of the ECOPC decision process is provided for each AEU by medium in Tables 2.1 through 2.8. Within these tables, summary information for total PAH values in sediment is provided for each AEU. Justification for background decisions are provided in Attachment 3.

2.3.1 ECOPCs for the RC AEU

Surface Water

Table 2.1 summarizes the results of the surface water ECOPC identification process for the RC AEU. There were 7 total inorganics (aluminum, barium, beryllium, cyanide, iron, lithium, and vanadium), 5 dissolved metals (cadmium, copper, lead, mercury and silver), no organics, and 1 radionuclide (radium-226) with MDCs greater than ESLs. Ammonia was not measured in RC AEU surface water and the potential for risk to aquatic life from this ECOI is uncertain.

Of these ECOIs, 2 were detected in less than 5 percent of the samples:

- Mercury was detected in 1 of 41 samples (Figure 2.1)
- Silver was detected in 1 of 42 samples (Figure 2.2)

The single detected concentrations of mercury and silver were greater than their respective ESLs. Elevated detection limits for some silver samples introduces uncertainty into the risk assessment. This uncertainty is discussed in detail in Attachment 1 and Section 6.1. However, given the isolated nature of these single detections (Figure 2.1 and 2.2), these metals are not likely to pose a risk to aquatic life and were eliminated from further consideration as ECOPCs.

Of the remaining inorganic ECOIs in surface water, copper (dissolved), aluminum (total), iron (total), and vanadium (total) were not statistically greater than background. These contaminants were eliminated from further consideration because they are not expected to present risks to the populations of receptors that inhabit Rock Creek greater than those expected in local background areas.

Further review of the data identified cyanide and radium-226 as only occurring within the background data set. Therefore, these chemicals were eliminated from further consideration as ECOPCs.

While the MDCs for barium (total), beryllium (total), and lithium (total) in surface water were greater than their respective ESLs, the UTL EPCs for these ECOIs were less than the ESLs (Table 2.1); therefore, they may be eliminated as ECOPCs. However, to ensure that these ECOIs were not a concern in surface water for an primary habitat area within a pond in Rock Creek , the spatial distributions of these ECOIs were evaluated by plotting the concentrations in relation to the ESL. The spatial distributions of these contaminants are shown in Figures 2.3 through 2.5. A summary of their spatial extent as compared to their respective ESLs is described as follows:

- Barium and beryllium were detected at concentrations greater than their respective CRA Methodology ESLs at one upstream location within the channel, (Figures 2.3 and 2.4). Barium was detected in all but one sample and all non detected beryllium samples had proxy values less than the chronic ESL. These ECOIs can, therefore, be removed from additional consideration as ECOPCs.

- Lithium had detected concentrations exceeding the ESL at an upstream and one downstream location (Figure 2.5). Detected concentrations at all other sample locations did not exceed ESLs. All non-detected lithium samples had proxy values less than the chronic ESL. Lithium can, therefore, be removed from further consideration as an ECOPC.

Cadmium (dissolved) and lead (dissolved) were evaluated in the professional judgment step (Attachment 3). The weight of evidence presented within professional judgment suggested that elevated concentrations of cadmium (dissolved) and lead (dissolved) in RC AEU surface water were not likely to be the result of RFETS activities, but may be representative of naturally occurring concentrations. There is no evidence of a release of these chemicals from potential sources inside or outside the AEU that would impact concentrations in surface water. Therefore, these chemicals are not considered ECOPCs in surface water for the RC AEU and are not further evaluated quantitatively.

As a result of the ECOPC identification process, no ECOPCs were identified for surface water in RC AEU.

Sediment

Table 2.2 summarizes the results of the sediment ECOPC identification process. There were 12 inorganic ECOIs (aluminum, antimony, arsenic, barium, cadmium, iron, lead, manganese, nickel, selenium, silver, and zinc) and 4 organics (2-butanone, 4-methylphenol, pentachlorophenol, and total PAHs) with MDCs greater than ESLs.

All of these ECOIs had detection frequencies greater than 5 percent. Total PAHs were detected in two sediment samples within RC AEU. In one sample the sum total PAH concentration was greater than the ESL. In that sample, benzo(a)pyrene was the only detected PAH and it was detected at a concentration lower than the benzo(a)pyrene ESL. All other PAHs were not detected but detection limits for all other PAHs were elevated above the ESLs. The summation of the proxy values for non-detected PAHs with the detection of benzo(a)pyrene resulted in a total PAH concentration greater than the ESL. While some uncertainty exists regarding the true total PAH concentration in that sample (SD0291WC), the single detection of benzo(a)pyrene at a concentration less than its ESL does not appear to warrant selection of total PAHs as an ECOPC for RC AEU sediments. Uncertainties related to elevated proxy values for non-detected chemicals are discussed in Section 6.

Of the remaining inorganic ECOIs in sediment, manganese was not statistically greater than background. This contaminant was eliminated from further consideration because it is not expected to present a risk to the populations of receptors that inhabit Rock Creek greater than the risk expected from local background conditions.

Further review of the data during the background comparison identified that antimony, 2-butanone, and 4-methylphenol were detected only within the background data sets. Therefore, these analytes were eliminated from further consideration as ECOPCs.

The MDC of nickel exceeded the ESL but the UTL EPC (which includes proxy values for non-detected samples) was less than the ESL (Table 2.2). To ensure that this ECOI was not a concern in sediment for any isolated aquatic populations associated with Rock Creek, the spatial distribution of nickel was evaluated by mapping the concentrations (Figure 2.6). A summary of the spatial extent with consideration of the ESLs is described:

- Nickel was found at a detected concentration exceeding the ESL at only one location, located near the middle of RC AEU (Figure 2.6). This spatial distribution of nickel indicates that while there may be a small area of elevated concentrations within habitat areas, the spatial extent of these areas are limited. Nickel can, therefore, be removed from further consideration as an ECOPC.

The weight of evidence presented within professional judgment shows that aluminum, arsenic, barium, cadmium, iron, lead, selenium, silver, and zinc concentrations in sediment in the RC AEU were not likely to be a result of RFETS activities, but rather may be representative of naturally occurring concentrations (Attachment 3). In addition, there are no documented source areas or operations/activities that occurred in the AEU related to pentachlorophenol. Consequently, there is no evidence of a release of these chemicals from potential sources inside or outside the AEU that would impact concentrations in sediment. Therefore, these chemicals are not considered ECOPCs in sediment for the RC AEU and are not further evaluated quantitatively.

As a result of the ECOPC identification process, no ECOPCs were identified for sediments in RC AEU.

2.3.2 ECOPCs for the MK AEU

Surface Water

Table 2.3 summarizes the results of the surface water ECOPC identification process for the MK AEU. There were 3 total inorganics (aluminum, iron, and vanadium), 5 dissolved metals (cadmium, copper, lead, silver, and zinc), no organics, and no radionuclides with MDCs greater than ESLs.

Of these ECOIs, silver was detected in less than 5 percent of the samples:

- Silver was detected in 1 of 26 samples (Figure 2.7)

The single detected concentration of silver was greater than the ESL, but this only represents one location. Thirteen of 25 non-detected samples had proxy values that were greater than the chronic ESL introducing some uncertainty into the risk assessment. This uncertainty is discussed in detail in Section 6.1. However, given the isolated nature of this single detection (Figure 2.7); and the relatively high proportion of proxy values adequate to determine the potential for chronic risk, silver was eliminated from further consideration as an ECOPC.

Of the remaining inorganic ECOIs in surface water copper (dissolved), lead (dissolved), and vanadium (total) were not statistically greater than background. These contaminants were eliminated from further consideration because they are not expected to present risks to the populations of receptors that inhabit McKay Ditch greater than those expected in local background areas.

The MDCs for cadmium (dissolved), zinc (dissolved), aluminum (total), and iron (total) exceeded than their respective ESLs, and the UTL EPCs for these ECOIs also exceeded their ESLs (Table 2.3); therefore, they were not be eliminated as ECOPCs.

Results of professional judgment evaluations indicate that these chemicals require further evaluation within risk characterization because these ECOPCs demonstrate a spatial pattern associated with former source areas.

Results of the ECOPC identification process for surface water to this point identified cadmium (dissolved), zinc (dissolved), aluminum (total), and iron (total) as surface water ECOPCs at MK AEU requiring further evaluation within the risk characterization.

Sediment

Table 2.4 summarizes the results of the sediment ECOPC identification process. There were 10 inorganic ECOIs (aluminum, antimony, chromium, copper, fluoride, iron, lead, nickel, selenium, and zinc) and 1 organic (4-methylphenol) with MDCs greater than ESLs. Total PAHs also exceeded the sediment ESL.

All of these ECOIs had detection frequencies greater than 5 percent.

Of the remaining inorganic ECOIs in sediment, copper, iron, lead, and zinc were not statistically greater than background. These contaminants were eliminated from further consideration because they are not expected to present a risk to the populations of receptors that inhabit McKay Ditch greater than the risk expected from local background conditions.

Antimony and 4-methylphenol were only detected in the background samples representing MK AEU. Therefore, these were eliminated from further consideration as ECOPCs.

95th UTLs exceeded ESLs for all the remaining ECOPCs; therefore, they could not be eliminated as ECOPCs.

Results of professional judgment evaluations indicate that these chemicals require further evaluation within risk characterization because these ECOPCs demonstrate a spatial pattern associated with former source areas.

Results of the ECOPC identification process for sediment indicated that aluminum, chromium, fluoride, nickel and selenium are ECOPCs requiring further evaluation within the risk characterization. Total PAHs were also determined to be an ECOPC for MK AEU sediment (Attachment 6) and will be evaluated further within the risk characterization section.

2.3.3 ECOPCs for the NN AEU

Surface Water

Table 2.5 summarizes the results of the surface water ECOPC identification process for the NN AEU. There were 7 total inorganics (aluminum, ammonia [unionized], barium, beryllium, iron, lithium, and vanadium), 6 dissolved metals (cadmium, copper, lead, selenium, silver, and zinc), 5 organics (bis[2-ethylhexyl]phthalate, di-n-butylphthalate, phenanthrene, phenol, and pyrene), and no radionuclides with MDCs greater than ESLs.

Of these ECOIs, 2 were detected in less than 5 percent of samples:

- Cadmium (dissolved) was detected in 1 of 32 samples (Figure 2.8)
- Pyrene was detected in 1 of 22 samples (Figure 2.9)

The single detected concentrations of cadmium and pyrene were greater than their respective ESLs. Proxy values for non-detected samples were greater than the ESL in some of the cadmium samples and all pyrene samples. This introduces uncertainty into the risk assessment which is discussed in detail in Attachment 1 and Section 6.1. However, given the isolated nature of these single detections (Figure 2.8 and 2.9), these metals were eliminated from further consideration as ECOPCs.

Of the remaining inorganic ECOIs in surface water, copper (dissolved), aluminum (total), iron (total), and vanadium (total) were not statistically greater than background. These contaminants were eliminated from further consideration because they are not expected to present risks to the populations of receptors that inhabit NN AEU greater than those expected in local background areas.

While the MDCs for beryllium (total) and lithium (total) in surface water were greater than their respective ESLs, the UTL EPCs for these ECOIs were less than the ESLs (Table 2.5); therefore, they may be eliminated as ECOPCs. However, to ensure that these ECOIs were not a concern in surface water for an primary habitat within NN AEU, the spatial distributions of these ECOIs were evaluated by plotting the concentrations in relation to the ESL. The spatial distributions of these contaminants are shown in Figures 2.10 through 2.11. A summary of their spatial extent relative to their respective ESLs is described as follows:

- Beryllium was detected at concentrations greater than the ESL at one location downstream of the East Landfill Pond (Figure 2.10). Lithium only had detected concentrations exceeding the ESL at the outlet of the East Landfill Pond (Figure 2.11). Detected concentrations at all other sample locations did not exceed ESLs, and it is unlikely that these few exceedances pose a risk to aquatic life. In addition, non-detected samples typically had proxy values less than their respective ESLs.

Results of professional judgment evaluations indicate that the remaining chemicals require further evaluation within risk characterization because these ECOPCs demonstrate a spatial pattern associated with former source areas.

Results of the ECOPC identification process for surface water identified lead (dissolved), selenium (dissolved), silver (dissolved), zinc (dissolved), ammonia (unionized) barium (total), bis(2-ethylhexyl]phthalate, di-n-butylphthalate, phenanthrene, and phenol as surface water ECOPCs at NN AEU requiring further evaluation within the risk characterization.

Sediment

Table 2.6 summarizes the results of the sediment ECOPC identification process. There were 5 inorganic ECOIs (aluminum, barium, iron, lead, and manganese) and 8 organics (benzo[a]anthracene, benzo[a]pyrene, benzo[g,h,i]perylene, chrysene, indeno[1,2,3-cd]pyrene, phenanthrene , pyrene, and total PAHs) with MDCs greater than ESLs.

All of these ECOIs had detection frequencies greater than 5 percent.

Only manganese was not statistically greater than background. This contaminant was eliminated from further consideration because it is not expected to present a risk to the populations of receptors that inhabit NN AEU greater than the risk expected from local background conditions.

95^{th} UTLs exceeded ESLs for all the remaining ECOPCs; therefore, they could not be eliminated as ECOPCs.

Results of professional judgment evaluations indicate that the remaining chemicals require further evaluation within risk characterization because these ECOPCs demonstrate a spatial pattern associated with former source areas.

Results of the ECOPC identification process for sediment indicated that aluminum, barium, iron, lead, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, chrysene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene are ECOPCs requiring further evaluation within the risk characterization section. Total PAHs were also determined to be an ECOPC for NN AEU sediment (Attachment 6) and will be evaluated further within the risk characterization section.

2.3.4 ECOPCs for the SE AEU

Surface Water

Table 2.7 summarizes the results of the surface water ECOPC identification process for the SE AEU. There was 1 total inorganic (aluminum) and one dissolved metal (silver), no organics, and no radionuclides with MDCs greater than ESLs.

Of these ECOIs, both were detected at detection frequencies greater than 5 percent and were not excluded based on detection frequencies.

Aluminum (total) was not statistically greater than background and was eliminated from further consideration because it is not expected to present risk to the populations of receptors inhabiting SE AEU greater than those expected in local background areas. Silver (dissolved) was carried into the professional judgment step where it was determined by weight of evidence that concentrations in SE AEU surface water were not likely to be a result of RFETS activities, but rather are representative of naturally occurring concentrations (Attachment 3). There is no evidence of a release from potential sources inside or outside the SE AEU that would impact silver concentrations in surface water. Silver is not considered an ECOPC in surface water for the SE AEU and, therefore, is not further evaluated quantitatively.

As a result of the ECOPC identification process, no ECOPCs were identified for surface water in SE AEU.

Sediment

Table 2.8 summarizes the results of the sediment ECOPC identification process. There were 4 inorganic ECOIs (aluminum, barium, iron, and selenium) with MDCs greater than ESLs.

All of these ECOIs had detection frequencies greater than 5 percent. Aluminum, barium, and iron were statistically greater than background. Background comparisons were not performed for selenium.

EPC-ESLs (95 UTLs) exceeded ESLs for all the ECOPCs; therefore, they could not be eliminated as ECOPCs.

Upon completion of the above process, aluminum, barium, iron, and selenium required further ECOPC evaluation using professional judgment (Attachment 3). The weight of evidence presented within professional judgment indicated that aluminum, barium, iron, and selenium concentrations in sediment in the SE AEU were not likely a result of RFETS activities, but rather were likely to be representative of naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the EU that would impact aluminum concentrations in sediment. These ECOIs were, therefore, removed from further consideration as ECOPCs.

As a result of the ECOPC identification process, no ECOPCs were identified for sediments in SE AEU.

3.0 ECOLOGICAL EXPOSURE ASSESSMENT

An exposure pathway describes a specific environmental route by which an individual receptor could be exposed to contaminants present at or originating from a site. A complete exposure pathway includes five elements: source, mechanism of release, transport medium, exposure point, and intake route. If any of these elements are missing, the pathway is considered incomplete. It is assumed that aquatic life may be exposed to surface water and sediment-related ECOPCs primarily via direct contact with surface water and sediment.

The ECOPC identification steps identified ECOPCs for both surface water and sediment for the AEUs (RC AEU, MK AEU, NN AEU and SE AEU). The 95th UTL for each ECOPC (or the MDC, whichever was less) was used as the EPC for evaluating exposure to each ECOPC within surface water and sediment (Tables 3-1 and 3-2).

It was assumed that the population of receptors obtain 100 percent of their exposure from each respective AEU. The assessment endpoints indicate that the population of receptors is defined as the entire population of aquatic life that could be exposed in suitable habitat across the entire AEU. In the interest of being conservative, it was also assumed that ECOPCs in possible marginal habitat areas that might be connected to the drainage hydrology (which were sampled due to the presence of surface water and/or wetted sediment) were also included in the risk characterization. This assumption may overestimate the exposure to these receptors because the hydrologic connectivity is unknown, however, these data are likely to be representative of groundwater releases to surface water.

In order to evaluate more current and realistic exposure conditions within the risk characterization, data collected ‘post-1999’ (from 1/1/2000 to present) were given the most weight in the surface water risk estimation, as well as surface sediment (0 – 6 inches in depth) because these data represent the most appropriate exposure estimates for the assessment endpoints associated with the AEU. The post-1999 surface water data results reflect more current and appropriate exposure conditions than older data. Similarly, the surface sediment reflects the depth of sediment typically associated with exposure to the aquatic receptor where the exposure pathway is potentially complete. These two media were evaluated as part of the chemical risk lines of evidence for the risk characterization and the data are summarized in Attachment 6.

4.0 ECOLOGICAL TOXICITY ASSESSMENT

The ESLs presented in the CRA Methodology are concentrations below which adverse effects are not expected and provide a conservative lower bound indicating concentrations at which the potential for adverse effects are possible.

Several ECOPCs were identified for both surface water and sediment in the AEUs (Section 2.0). All toxicity values used in the risk characterization are provided in Tables 4-1 and 4-2.

For sediments, as an additional measure of potential toxicity, TRVs that are representative of concentrations above which adverse effects are expected to some portion of the aquatic community were also identified. While sediment ESLs provide a low value of no effects to threshold effects analogous to a no effect concentration (NOEC), below which effects are unlikely to occur, upper-bound estimates of concentrations for each ECOPC (above which exists an increased potential for adverse effects) were identified in the published literature and are referred to as LOEC values. Concentrations that occur between these upper- and lower-bound values are of uncertain but potential toxicity, but in this range population-level risks are expected to be low. These values were identified for consideration in the risk characterization of ECOPCs to provide literature-derived toxicity values that are reasonable estimates of upper-bound concentrations above which the potential for adverse effects are possible (Attachment 5).

For surface water, chronic and acute water quality criteria were provided in the CRA Methodology for most ECOPCs. Long-term average exceedances of chronic criteria can be indicative of effects to sensitive genera and populations of aquatic receptors. Acute criteria are typically based on mortality endpoints over shorter periods of time than chronic criteria and periodic exceedances of acute criteria may be indicative of potential risk to aquatic receptors.

5.0 AEU-SPECIFIC ECOLOGICAL RISK CHARACTERIZATION

Risk characterization focuses on the overall results for each assessment endpoint. These risks are characterized in the following sections for the populations of aquatic and semi-aquatic receptors in each AEU, as appropriate based on the assessment endpoints. As noted by EPA (1997), a well-balanced risk characterization should "...present risk conclusions and information regarding the strengths and limitations of the assessment for other risk assessors, EPA decision-makers, and the public."

Risk characterization has two main components: the risk estimation and the risk description. The risk estimation summarizes the results of the analysis, including the presentation of the hazard quotients calculated using all of the various datasets discussed earlier. Risks are estimated by taking into account ECOPC concentrations using both spatial and temporal data. The risk description then provides context for the analysis, including the proportions of Sitewide habitats that are affected, and interpretation of overall results including data from the Draft Watershed ERA (DOE 1996).

In general terms, the risk estimation relies on a hazard quotient (HQ) approach to provide an indication of the potential for risk based on exposure to ECOPCs. HQs represent the ratio of the estimated exposure of a receptor to an ECOPC to a TRV that is associated with a known level of toxicity.

The risk description then incorporates the results of the risk estimates along with the other lines-of-evidence pertinent to the assessment endpoints and the uncertainties associated with the risk estimations to evaluate potential chemical-based effects on ecological receptors. Information considered in the risk description includes receptor groups potentially affected; type of TRV exceeded (e.g., NOEC versus LOEC; chronic versus acute); and risk associated with background conditions. In addition, other site-specific habitat-based information and regional factors were considered. Information regarding the historical RFETS-related use of a given ECOPC within the AEU and/or potential for transport of the ECOPC from a areas of historical operations to the AEU is also considered.

The risk characterization methods described in this section apply to all non-threatened or endangered species. The risk characterization was conducted separately for each abiotic medium from habitats appropriate for aquatic life (i.e. streams and ponds) and areas that represent potential source areas for the potential discharge of contaminants in groundwater to surface water (i.e. seeps or wetlands). Data were aggregated, as described above from AEU samples, and appropriate EPCs were calculated (e.g. 95 UTL). Concentrations at each sampling location were mapped and comparisons to RFETS background concentrations were made to determine whether the Site represents incremental risk above background concentrations.

The conclusions reached in the risk characterization for each AEU are based on the result of the risk evaluation including the uncertainty analysis and the combined lines-of-evidence discussed in the risk description. These other lines of evidence include results from previous ecological risk assessments conducted in the on-site watersheds and the results of the extensive site-specific ecological monitoring at the site. The results of the HQ-based risk estimation are discussed separately for each assessment endpoint and AEU. The remaining lines of evidence are presented in a separate section for each AEU following the risk estimation. A conclusions section is then provided to describe the overall risk conclusions for aquatic ecosystem assessment endpoints in each AEU based on surface water and sediment chemical risk and other pertinent risk assessment approaches.

Characterization of risk focuses on multiple lines of evidence (LOEs) for each assessment endpoint. This includes discussion of the potential for risk from exposure to ECOPCs in surface water and sediment for aquatic ecosystem assessment endpoints based on the following chemical-specific lines of evidence.

<u>Surface Water</u>

- Comparison of EPCs to chronic water quality criteria (also referred to as chronic ESLs)
- Comparison of EPCs to acute water quality criteria
- Frequency of exceedance of chronic and acute water quality criteria
- Spatial distribution of water quality criteria exceedances in relation to aquatic habitat
- Temporal trends in surface water ECOPC concentrations
- Background comparisons.

<u>Sediment</u>

- Comparison of EPCs to NOEC or threshold-based sediment concentrations (also referred to as NOEC ESLs)

- Comparison of EPCs to LOEC-based sediment concentrations
- Frequency of exceedance of NOEC and LOEC sediment concentrations
- Spatial distribution of NOEC and LOEC exceedances in relation to aquatic habitat
- Evaluation of surface sediment concentrations in relation to NOEC and LOECs.
- Evaluation of surface soil samples adjacent to aquatic systems as a potential future exposure scenario.
- Background comparisons.

Chemical risk characterization utilizes quantitative methods to evaluate potential risks to ecological receptors. In this risk assessment, the quantitative method used to characterize chemical risk is the HQ approach. For sediment, HQs are interpreted as follows:

HQ Values		**Interpretation of HQ Results**
NOEC-based	**LOEC-based**	
≤ 1	≤ 1	Minimal or no risk
> 1	≤ 1	Low level risk[a]
> 1	> 1	Potential adverse effects.

[a] Assuming magnitude and severity of response at LOEC are relatively small and based on endpoints appropriate for the assessment endpoint of the receptor considered.

One potential limitation of the HQ approach is that calculated HQ values are often uncertain due to simplifications and assumptions in the underlying exposure and toxicity data used to derive the HQs. Where relevant, this risk assessment provides information on the uncertainty related to the HQs. General uncertainties are discussed in Section 6 while uncertainties specific to a particular chemical risk characterization are discussed in the risk characterization.

For surface water, NOEC and LOEC concentrations are not typically available. Rather, chronic criteria are intended to be protective of 95% of aquatic species (5-CCR-1002-31.10) and can be thought of as analogous to NOEC concentrations based on (but not limited to) survival, growth and reproduction of aquatic receptors. Long-term average exceedances of chronic criteria can be indicative of effects to sensitive genera and populations of aquatic receptors. Acute criteria are not, however, analogous to LOEC concentrations. Acute criteria are typically based on mortality endpoints over shorter periods of time than chronic criteria and consistent exceedances of acute criteria may be indicative of potential risk to aquatic receptors.

Divalent metals and uranium in surface water were all reviewed using available site-specific hardness conditions. Site measurements of pH were included in calculations for ammonia and pentachlorophenol to develop appropriate chronic and acute criteria. These methods and results are described in greater detail in Attachment 5 and result in different criteria for each AEU based on the average measures of the hardness, pH and temperature values. The uncertainty associated with the use of AEU-average water parameters to derive acute and chronic criteria is discussed in Section 6. Using this approach, risks may be underestimated if slightly elevated concentrations of hardness-dependant metals are detected in surface waters with hardness values lower than the mean. Alternatively, risks may be overestimated if slightly elevated concentrations are detected at hardness values greater than the mean.

The process of risk description incorporates results of the chemical-based risk estimation with other lines-of-evidence directly applicable to the aquatic receptor assessment endpoints to evaluate the potential for risks to aquatic receptors in the AEUs. These results are also reviewed in terms of the findings of the uncertainty analysis (Section 6). Information considered in the risk description includes receptor groups potentially affected, type of TRV exceeded (e.g., NOEC versus LOEC), risk above background conditions, results of ecosystem monitoring studies, previous risk assessment efforts, and toxicity testing of surface water and sediments. In addition, other site-specific and regional factors are considered such as the use of a given ECOPC within the EU related to historical RFETS activities, comparison of ECOPC concentrations within the AEU to the rest of the RFETS as it relates to background, and/or comparison to regional background concentrations.

These data, where available, are presented systematically for each AEU in the risk description and an overall conclusion for potential risk that is based on the weight of each of the lines of evidence is provided for use in the risk management of the aquatic ecosystems at the site.

Attachment 7 provides a summary of other LOEs gathered from previous studies that were conducted within RFETS and which focused on the AEUs. Previous studies completed within RFETS that encompass aquatic life measurement endpoints fell within the following four categories:

- Tissue Analyses – Sampling and analysis to determine bioaccumulation and bioconcentration trends;
- Aquatic Population Studies – Evaluated populations and ecosystem structure of benthic macroinvertebrates and fish within RFETS;
- Bioassay Analyses – Measured direct toxicity effects to laboratory test organisms from RFETS surface water or sediment;
- Waterfowl/Wading Bird Risk Assessments – Determined the potential impacts to these higher trophic level receptors by assessing their potential exposure to aquatic species as food sources.

A summary of findings is presented within the risk characterization and is used in conjunction with the chemical risk estimation to draw overall weight-of-evidence risk conclusions.

5.1 Rock Creek Drainage AEU Risk Characterization

No ECOPCs in either surface water or sediment were identified using the ECOPC identification process (Section 2). RC AEU is not hydrologically connected to the IA. Only the Roadway Spraying PAC which may be associated with PAHs is within the drainage associated with RC AEU. No further chemical risk characterization for the aquatic community assessment endpoint is required.

5.1.1 Ecosystem Data

Several studies have been conducted which characterize historical and more current ecological conditions in the RC AEU. Pertinent conclusions from these studies are provided here while more detailed summarizations are provided in Attachment 7. These studies, which include assessments of aquatic communities and populations, have been conducted in the RCAEU since 1991.

Aquatic Community Studies

Fish, benthos and aquatic habitat characteristics have been measured during several field seasons and collectively these data provide useful information concerning the quality and health of the aquatic system as a whole. In addition, characterizing the physical habitat provides an important understanding of the quality and quantity of habitat available for aquatic species to utilize. Samples were collected and evaluated to determine the benthic community composition and metrics such as species richness, density, and diversity were derived to provide insights on conditions within a given aquatic habitat that influences community structure. The results of fish surveys provide similar information on the physical, biological, and chemical conditions within a water body.

Rock Creek is best characterized as an intermittent stream fed mainly by numerous groundwater seeps (Ebasco 1992). Groundwater seeps discharging to Rock Creek or its tributaries create many small perennial pools which are critical habitat for aquatic species. Lindsay Pond is the only pond, out of three, that maintains full pool throughout the year. In WWE’s (1995) bioassessment of Walnut and Woman Creeks, Lindsay Pond was used as a reference pond because it is relatively undisturbed and is not likely to be influenced by RFETS. No habitat data was collected from the Rock Creek stream channel as part of the 1994 habitat assessment conducted by WWE (1995).

Aquatics Associates (2003) evaluated habitat in Rock Creek in 2001 and 2002. This study found that while flows were permanent at two stations on the North Fork of the Middle Fork of Rock Creek, flows are low and diminish at the downstream sampling stations located (1) downstream of Lindsay Pond, and (2) upstream of the North and South Fork confluence. At these lower stations, permanent pools exist, but mainstream channel flows are intermittent. The lack of water during summer months is the most limiting factor affecting habitat quality and adversely affects the establishment of fish and macroinvertebrate populations in Rock Creek (Aquatics Associates 2003).

Benthic Community

The benthic community in the RC AEU was sampled in 1991, 1994, and again in 2001 and 2002. Data from studies conducted in 2001 and 2002 were assessed using EPA's revised Rapid Bioasessment Protocols (RBPs) (Barbour et al. 1999). The study results provided the following information on the benthic community within the RC AEU:

- Taxa numbers in Rock Creek and Lindsay Pond in the spring and fall of 1991 at individual sampling sites and Lindsay Pond were relatively low and dominated by dipterans.
- Collectively, across all sites, Rock Creek contained 53 and 59 taxa for spring and fall sampling, respectively.
- WWE (1995) compared 1991 benthic macroinvertebrate data with that collected in 1994 and found that taxa richness in 1994 was much higher than in 1991, while the percent contribution of dominant taxa in 1994 was lower as compared to 1991.
- Sampling in 2001 and 2002 found that dipterans were the most common taxa collected (>33%), followed by Oligochaetes (21 %), Amphipods (13%), and mayflies (10.7 %). Stoneflies were found at higher numbers than in Woman Creek and consisted of species capable of burrowing into the stream's hyporheic zone as flows diminish.
- Total macroinvertebrate densities in Rock Creek were generally higher than in Woman or Walnut Creeks.
- Hilsenhoff Biotic Index (HBI) scores during all sampling events reflect scores typically associated with a tolerant benthic community.
- Invertebrate Community Index (ICI) scores for bioassessment studies conducted in 2001 and 2002 indicate the importance of flows as ICI scores at Rock Creek sampling sites varied widely based on the varying flow conditions. Despite the wide range in ICI scores, ranging from poor to good, Aquatics Associates (2003) indicates that the macroinvertebrate community in Rock Creek is probably the least stressed of the drainages evaluated.

Fish Community

Surveys of the fish community within the RC AEU were conducted on several occasions between 1991 and 2002. Both the pond and streams portions of the system were sampled; sampling methods ranged from seining, to minnow traps, to backpack electrofishing. The results of these surveys, most often conducted as presence/absence surveys, found the following:

- In Lindsay Pond, white sucker and largemouth bass were found, while fathead minnows were found at one stream site during 1991 surveys.

- Fish surveys in 2000 found fathead minnows present at 8 out of 9 locations in Rock Creek perennial pools, although the report indicates that stream flows were not continuous (Kaiser-Hill 2001).

- Aquatics Associates (2003) found that where water was present in the stream channel of Rock Creek, fathead minnows were the only fish species collected. At site RC2, downstream of Lindsay Pond, the population was reported as being naturally self sustaining.

- Fish are found in Lindsay pond and stream habitats of Rock Creek with sustained flows or permanent pools, although diversity is low in the main stream channel due to lack of flows.

Summary

In summary, results of studies conducted between 1991 and 2002 indicate that the aquatic communities within the RC AEU streams and Lindsay ponds reflect the physical limitations of the available habitat. Aquatic population and community data in the RC AEU, collected from two distinct types of habitats, ponds and streams, are generally indicative of a diverse, robust community in those locations where flow is typically sustained. WWE (1995) used Lindsay pond as a reference pond for its comparison of Woman and Walnut Creek ponds and found that metrics for Lindsay Pond were in the middle range for the ponds sampled.

Stream sites on Rock Creek generally had higher macroinvertebrate densities than Woman or Walnut Creeks. Rock Creek species were dominated by species tolerant of environmental stresses based on HBI and ICI scores, although the Rock Creek benthic community was suggested to be one of the least stressed of the three drainages evaluated. Collectively, data from these studies suggest that the stressors to the aquatic community in Rock Creek are correlated with the adequate flow and that the stream is similar to other small streams located in a semi-arid transition zone.

5.1.2 Waterfowl and Wading Birds

DOE (1996) did not evaluate risks to aquatic feeding birds within the Rock Creek Drainage, however, the risk assessments performed on the Walnut and Woman Creek drainages provide a tool for determining the potential for risk to wading birds and waterfowl that may utilize the aquatic habitats in the RC AEU.

The previous risk assessment identified Aroclor-1254, mercury, di-n-butylphthalate and antimony as potential risk drivers in the Walnut and Woman Creek drainages. PCBs were determined to be risk drivers for the heron and mallard based on exposure to sediments and from PCBs that had accumulated in the food chain. PCBs were not detected in RC AEU sediments. No significant risks were predicted for the heron or mallard in NW AEU, SW AEU or WC AEU (CRA Volume 15B1) with PCB concentrations in sediment at concentrations considerably higher than any that could be expected in RC AEU. Therefore, no risks to the heron or mallard receptors are predicted in the RC AEU.

Antimony was also selected as an ECOPC for the heron receptor in the Woman Creek drainage. Exposure via sediments at maximum concentrations (51.3 mg/kg) were not expected to cause risk. The MDC in RC AEU is equal to 11.1 mg/kg. Therefore, no risks are expected to the heron or mallard receptors in the RC AEU.

Mercury was determined to be an ECOPC for the heron receptor in the Walnut Drainage based on exposure to mercury in fish that were predicted to have bioaccumulated mercury present in sediments. Again, no significant risks were expected with maximum sediment concentrations equal to 1.6 mg/kg. The MDC for mercury in sediments in RC AEU was equal to 0.066 mg/kg indicating that risks from exposure to mercury are likely to be low.

Finally, di-n-butylphthalate was identified as an ECOPC in DOE (1996) for the mallard receptor due to exposure in surface water. Di-n-butylpthalate was not detected in RC AEU surface waters and risks are, therefore, expected to be low.

There is moderate uncertainty in these conclusions since habitat types and presence of potential ECOPCs in RC AEU are different than those identified in Walnut and Woman creeks. If concentrations of ECOPCs in Rock Creek other than those identified in the drainages assessed in the previous risk assessment are elevated above those found in NW AEU, SW AEU and WC AEU, then risks are unknown for those chemicals. Given the buffer zone nature of the RC AEU, little to no site-related contamination is expected in RC AEU (Attachment 3) and the potential for underestimation of risks using the risk conclusions from DOE (1996) is low.

5.1.3 Uncertainty Analysis

General uncertainties applicable to RC AEU, MK AEU, NN AEU, and SE AEU are discussed in Section 6. Uncertainties specific to the lines of evidence presented in the previous sections are discussed where appropriate within each section above.

5.1.4 Risk Conclusions

Multiple LOEs were gathered to evaluate the aquatic risk conditions within the RC AEU. No ECOPCs were identified in RC AEU surface water or sediments indicating that site-related risks are likely to be low. Additional LOEs gathered from ecosystem and aquatic population studies as well as the results of previous risk assessments were also compiled. Low risks are predicted for waterfowl and wading birds based on a review of previous risk assessment activities with respect to conditions within the RC AEU. There is moderate uncertainty in the waterfowl risk since study conclusions for Walnut and Woman Creek drainages were used to infer potential risks within RC AEU.

The ecosystem of RC AEU appears to be heavily influenced by the hydrologic conditions within the drainage. In areas where perennial surface water is found, the aquatic community appears to be viable and indicative of the type of system that would be expected to be found within similar habitats outside of RFETS. The risk conclusions for RC AEU are summarized in Table 5.1.

5.2 McKay Ditch AEU Risk Characterization

Multiple ECOPCs in both sediment and surface water were identified for the MK AEU in Section 2. Portions of the MK AEU are adjacent to the IA, all chemical groups from which ECOPCs were identified may be present in surface water and/or sediment due to historical sources at RFETs. Professional judgment was not used to eliminate any ECOIs from further consideration as ECOPCs.

The following sections provide the chemical-specific risk evaluation and a description of the risk to populations of aquatic receptors in the AEU based on the combination of the risk description, uncertainty analysis and all other applicable LOEs.

5.2.1 Chemical Risk Estimation for the MK AEU

Aluminum (total), cadmium (dissolved), iron (total) and zinc (dissolved) were identified as surface water ECOPCs for the MK AEU. Table 5.2 presents the HQ results for the surface water ECOPCs. Table 5.3 presents the HQ results for the post-1999 surface water dataset.

Similarly, Table 5.4 presents the HQ results for the sediment ECOPCs in the MK AEU. Inorganic ECOPCs for sediment include aluminum, antimony, chromium, fluoride, nickel and selenium. Organic ECOPCs in sediment include 4-methylpheno and total PAHs. Table 5.5 presents the HQ results for the ECOPCs in surface sediment (0-6”).

Many ECOPCs for which risks are assessed in the CRA are naturally occurring constituents in the soils, sediments and surface waters at RFETS. Since the focus of the CRA is evaluating risks associated with residual site-related contamination following accelerated actions, it is important to calculate the risks that would be predicted at naturally occurring concentrations using the same assumptions and models as used in the CRA. Risks calculated using background data can provide additional information on the magnitude of potentially site-related risks. Hazard quotients for aquatic receptors at background EPCs are presented in Table 5.13 for surface water and 5.14 for sediments. In addition, some anthropogenic organic chemicals may also have been released from historic IHSSs at the site. While these may also be found in uncontaminated areas, no background comparison was conducted for organic ECOPCs.

Aluminum

Aluminum was identified as an ECOPC in both surface water and sediment in the MK AEU. Surface water concentrations exceeded the chronic AWQCs in MK AEU surface water in all samples. In background surface waters, 37 percent of samples were detected at concentrations that exceeded the chronic AWQC. In sediments, NOEC concentrations are slightly exceeded both by the AEU-wide EPC and in three individual samples (all HQs < 5), but the LOEC is not exceeded by either. Background aluminum data show a similar distribution.

Temporal trends in surface water indicate no apparent trends in aluminum concentrations in MK AEU surface water. The ranges of MK AEU and background data are similar and the mean concentration in background is greater than the chronic AWQC (Figure 5.1). Of the two samples collected in MK AEU since 1999, one sample exceeded the chronic AWQC while the other did not. Both were less than the mean background concentration.

Spatial evaluations indicate consistent distributions of exceedances of the chronic AWQC were observed in the areas within and adjacent to the IA or upstream of the IA. An HQ greater than 10 was calculated from a sample at the western boundary of RFETS. One location also had a concentration greater than the chronic AWQC just upstream of the confluence with Walnut Creek. (Figure 5.2).

Exceedances of the sediment NOEC (Figure 5.3) were noted at three sampling locations, one at the western boundary of RFETS, one within McKay Ditch and one within an intermittent drainage adjacent to the IAEU. The LOEC was not exceeded in any sample.

Concentrations in surface soils adjacent to surface water bodies in WC AEU (Attachment 6) were also compared to the NOEC and LOEC ESLs. Only one aluminum sample was available and the concentration was lower than both the NOEC and LOEC values for sediment.

Given the lack of LOEC exceedances in sediments, risks to the aquatic community assessment endpoint is likely to be low on an AEU-wide basis. No ponded areas of perennial habitat are present within the AEU. Consistent exceedances of the chronic AWQC indicate that risks cannot be ruled out for surface water. However, uncertainties in the proportion of aluminum that could be sorbed to particulate matter in the surface water suggest that site-related risks may be over-estimated using the aluminum AWQC. A review of the background data indicates that both sediment and surface water concentrations are similar to background concentrations. Exceedances of the aluminum AWQC were also noted at the western boundary of RFETS in an area that is upgradient of all known historical source of contaminants at the site.

Both the surface water and sediment dataset for aluminum are somewhat spatially limited. Data are available for both media at upstream and downstream locations with periodic sampling throughout most of the drainage, however, some large reaches of the drainage have never been sampled introducing low to moderate uncertainty into the risk characterization. Aluminum was detected in all samples indicating there are no uncertainties with the data set related to detection limits.

Overall, site-related risks to the aquatic community assessment endpoint from aluminum exposure in surface water and sediment are likely to be low.

Cadmium

Cadmium was identified as an ECOPC in surface water in the MK AEU. In sediments, the maximum detected concentration of cadmium was less than the ESL and it was, therefore, removed from further consideration as an ECOPC.

All detected concentrations of cadmium exceeded the chronic AWQC while the acute AWQC was exceeded in only one sample. Fifty-eight percent of the non-detected concentrations had proxy values in excess of the chronic AQWC while 39 percent also exceeded the acute AWQC. In the background dataset, neither the chronic nor the acute AWQCs were exceeded (Table 5.5), however, the background-specific AWQCs were appreciably higher than for the MK AEU due to the higher average water hardness in the background dataset.

Cadmium data were not available for MK AEU after the spring of 1995. Temporal trends in cadmium data indicate a somewhat decreasing trend in concentrations between 1991 and 1995 (Figure 5.4).

Spatial evaluations of surface water compared to the chronic and acute criteria are provided in Figures 5.5 and 5.6. The chronic AWQC is exceeded at three locations; one location within McKay ditch upstream of the IA,one location near the confluence with Walnut Creek, and one location from within an ephemeral drainage adjacent to the IA. The single acute exceedance was observed in 1992 in McKay ditch just upstream of the IA.

The cadmium surface water dataset is somewhat spatially limited. Data are available for both media at upstream and downstream locations with periodic sampling throughout most of the drainage, however, some large reaches of the drainage have never been sampled introducing low to moderate uncertainty into the risk characterization. Fifty-eight percent of the non-detected samples had proxy values in excess of the chronic AWQC and 39 percent also exceeded the acute AWQC. These results indicate that there is uncertainty with chronic risk results for cadmium. There is also uncertainty based on acute risks but that uncertainty is lower than for chronic risk since the majority of samples had proxy values lower than the acute AWQC. In addition, cadmium data are limited temporally so current risks are uncertain.

Chronic risks are predicted based on exceedances of the chronic AWQC in all detected samples. Considerably uncertainty is, however, present based on a lack of current data, elevated proxy values for non-detected samples, and a lack of available aquatic habitat based on the intermittent nature of the waterways in the AEU. Acute risks are expected to be low based on the single exceedance in 1992. However, since 39 percent of proxy values for non-detected samples also exceeded the acute AWQC, the uncertainty is moderate to high especially since current data were not available for evaluation.

Chromium

Chromium was identified as an ECOPC in sediment in the MK AEU. Maximum detected concentrations of chromium in surface water were lower than the chronic ESL; therefore, chromium was removed from further consideration as an ECOPC in surface water. In sediments, the NOEC ESL was exceeded slightly by the 95th UTL in sediment but the UTL was less than the LOEC value. One sample was greater than the NOEC while the LOEC was not exceeded. In the background dataset, all chromium samples were lower than the NOEC ESL.

A review of surface sediment (0-6") data indicates that the single detected sample was representative of surface sediments. The sample exceeded the NOEC but not the LOEC (Table 5.5). Additionally, the 95th UTL for surface sediments was slightly greater than the NOEC and less than the LOEC.

Spatial evaluations of sediment concentrations compared to the NOEC ESL and LOEC values in sediments are provided on Figure 5.7. The single exceedance of the NOEC ESL was noted outside of McKay ditch adjacent to the IA. All samples within McKay ditch were less than the NOEC and LOEC.

Concentrations in surface soils adjacent to surface water bodies in WC AEU (Attachment 6) were also compared to the NOEC and LOEC values. One sample was available for comparison. The concentration from the single sample was lower than both the NOEC and LOEC values for sediment.

The chromium dataset is somewhat limited in terms of number of samples. Data are available for both media at upstream and downstream locations with periodic sampling throughout most of the drainage, however, some large reaches of the drainage have never been sampled introducing low to moderate uncertainty into the risk characterization. Chromium was detected in nearly all samples with proxy values less than both the NOEC and LOEC values indicating very low uncertainty in the quality of chromium data.

The lack of exceedances of the LOEC value in sediments indicates that risks to the aquatic community assessment endpoint from chromium are likely to be low. No risks are expected from exposure to chromium in surface water.

Fluoride

Fluoride was identified as an ECOPC in sediment in the MK AEU. Maximum detected concentrations of fluoride in surface water were lower than the chronic ESL; therefore, fluoride was removed from further consideration as an ECOPC in surface water.

One surface sediment sample was available for fluoride in the MK AEU (Figures 5.8 and 5.9). The sample had a detected concentration equal to 8.47 mg/kg which is greater than both the NOEC and the LOEC. Fluoride data were not available in background sediments.

No samples were available within McKay Ditch. Conclusions based on chemical risk are uncertain due to the small sample size and lack of data from within McKay ditch.

Iron

Iron was identified as an ECOPC in surface water for the MK AEU. Sediment concentrations in MK AEU were not statistically greater than site-specific background concentrations and iron was, therefore, removed from further consideration as an ECOPC.

In surface water, the 95th UTL was greater than the chronic AWQC and no acute value was available. The majority of samples (74 percent) were detected at concentrations that exceeded the chronic AWQC. In background surface water, 35 percent of samples were detected at concentrations that exceeded the chronic AWQC.

Review of the most recent iron data in surface water (Table 5.3) indicates that the chronic AWQC has been exceeded in one of the two samples collected since 1999. Temporal trends in iron data indicate no apparent trend in iron concentrations (Figure 5.10) and the background and NW AEU datasets have similar ranges and mean concentrations. All MK AEU data are within the range of background surface water concentrations.

Spatial evaluations of surface water compared to the chronic AWQC are provided in Figure 5.11. The chronic AWQC was exceeded at six locations within McKay ditch with HQs greater than 5 at the western boundary of RFETS.

The surface water dataset for iron is somewhat spatially limited. Data are available for both media at upstream and downstream locations with periodic sampling throughout most of the drainage, however, some large reaches of the drainage have never been sampled introducing low to moderate uncertainty into the risk characterization. Iron was detected in all samples indicating the data set has no uncertainties related to detection limits.

Consistent exceedances of the chronic AWQC in both the MK AEU and background surface water datasets indicate that site-related risks are likely to be similar to risks encountered in background. While the proportion of samples greater than the chronic AWQC is higher on-site, review of the background data and temporal trends at the site indicates that the two datasets are of similar distributions. Site-related risks may be somewhat elevated over those expected to be found in background, but they are likely to be low. Site-related sediment risks are also likely to be low.

Nickel

Nickel was identified as an ECOPC in sediment in the MK AEU. Maximum detected concentrations of nickel in surface water were lower than the chronic ESL; therefore, nickel was removed from further consideration as an ECOPC in surface water. In sediments, the NOEC ESL was exceeded slightly by the 95th UTL in sediment but the UTL was less than the LOEC value. One sample was greater than the NOEC while the LOEC was not exceeded. In the background dataset, one nickel sample was greater than the NOEC ESL while all were lower than the LOEC.

A review of surface sediment (0-6”) data indicates that the single detected sample was representative of surface sediments. The sample exceeded the NOEC but not the LOEC (Table 5.5). Additionally, the 95th UTL for surface sediments was slightly greater than the NOEC and less than the LOEC.

Spatial evaluations of sediment concentrations compared to the NOEC ESL values in sediments are provided on Figure 5.13. The single exceedance of the NOEC ESL was noted outside of McKay ditch adjacent to the IA. All samples within McKay ditch were less than the NOEC and LOEC.

Concentrations in surface soils adjacent to surface water bodies in MK AEU (Attachment 6) were also compared to the NOEC and LOEC values. One sample was available for comparison. The concentration from the single sample was lower than both the NOEC and LOEC values.

The nickel dataset is somewhat limited in terms of number of samples. Data are available for both media at upstream and downstream locations with periodic sampling throughout most of the drainage, however, some large reaches of the drainage have never been sampled introducing low to moderate uncertainty into the risk characterization. Nickel was detected in nearly all samples with proxy values less than both the NOEC and LOEC values indicating very low uncertainty in the quality of nickel data.

The lack of exceedances of the LOEC value in sediments indicates that risks to the aquatic community assessment endpoint from nickel are likely to be low. No risks are expected from exposure to nickel in surface water.

Selenium

Selenium was identified as an ECOPC in sediment in the MK AEU. Maximum detected concentrations of selenium in surface water were lower than the chronic ESL; therefore, selenium was removed from further consideration as an ECOPC in surface water. In sediments, the NOEC and LOEC were both exceeded by the 95th UTL in sediment. Selenium was detected in one sample at a concentration greater than the NOEC and LOEC values. In the background dataset, five samples exceeded the NOEC while three exceeded the LOEC. The HQs calculated in background sediments were very similar to those calculated in MK AEU sediments.

A review of surface sediment (0-6”) data indicates that the single detected sample was representative of surface sediments. The sample exceeded both the NOEC and LOEC values (Table 5.5). Additionally, the 95th UTL for surface sediments were similar to the UTL calculated for the entire dataset.

Spatial evaluations of sediment concentrations compared to the NOEC ESL and LOEC values in sediments are provided on Figures 5.14 and 5.15. The single exceedance of the NOEC ESL was noted outside of McKay ditch adjacent to the IA. All samples within McKay ditch were less than the NOEC and LOEC.

Data were not available for surface soils adjacent to surface water bodies in the MK AEU (Attachment 6).

The selenium dataset is somewhat limited in terms of number of samples Data are available for both media at upstream and downstream locations with periodic sampling throughout most of the drainage, however, some large reaches of the drainage have never been sampled introducing low to moderate uncertainty into the risk characterization. Selenium was detected in only one sample and all non-detected samples had proxy values less than both the NOEC and LOEC values indicating very low uncertainty in the quality of selenium data.

The single exceedance of the LOEC value in sediments in an area of limited habitat quality indicates that risks to the aquatic community assessment endpoint from selenium are likely to be low. No risks are expected from exposure to selenium in surface water.

Zinc

Zinc was identified as an ECOPC in surface water in the MK AEU. Sediment concentration in MK AEU were not statistically greater than site-specific background concentrations and zinc was, therefore, removed from further consideration as an ECOPC.

In surface water, the 95th UTL was greater than the chronic AWQC. For zinc at the site-specific hardness used for MK AEU, the chronic and acute AWQCs for zinc are essentially equal. Fifteen percent of samples were detected at concentrations that exceeded the AWQCs. In background surface water, all samples were less than both AWQCs. Background-specific AWQCs were considerably higher than the MK AEU-specific values because water hardness was considerably higher in the background dataset.

No data were available for zinc in surface water after 1999 (Figure 5.16). All MK AEU data are within the range of background surface water concentrations. Temporal trends are uncertain in the pre-1999 data, however, the AWQCs were not exceeded in the most recent round of sampling.

Spatial evaluations of surface water compared to the chronic and AWQCs are provided in Figures 5.17 and 5.18. The chronic AWQC was exceeded at only one location within the MK AEU. That location was outside of McKay ditch within a small drainage area adjacent to the IA.

The surface water dataset for zinc is somewhat spatially limited. Data are available for both media at upstream and downstream locations with periodic sampling throughout most of the drainage, however, some large reaches of the drainage have never been sampled introducing low to moderate uncertainty into the risk characterization. Zinc was detected in most samples and those samples where zinc was not detected had proxy values less than the chronic and acute AWQCs. This indicates that uncertainty associated with non-detected samples is low.

Exceedances of the chronic and acute AWQCs were noted at one location outside of any aquatic habitat. No exceedances were noted within McKay ditch. Risks are not expected within McKay ditch, but cannot be ruled out in the area where exceedances of the AWQCs were noted. These risks are, however, uncertain due to the limited aquatic habitat in that area. Site-related sediment risks are likely to be low.

Polycyclic-aromatic Hydrocarbons (PAHs)

No individual PAHs were identified as ECOPCs in WC AEU sediments, however, total PAHs were identified as an ECOPC. At least one PAH was detected in two surface sediment samples from MK AEU. Both samples had total PAH concentrations greater than the NOEC ESL but less than the LOEC.

Figure 5.19 presents the locations of the two detected samples. One sample was within a small drainage adjacent to the IA while the second was located at the western RFETS boundary. Only one additional sample location was available, near the confluence with Walnut Creek. No PAHs were detected at that location.

PAHs were not detected in 6 samples. The proxy value in each of those samples was greater than the NOEC but less than the LOEC. This indicates that while there is uncertainty related to elevated proxy values in non-detected samples, the risk is likely to be limited since all proxy values are lower than the LOEC. Proxy values between the NOEC and LOEC are of low to moderate uncertainty since the NOEC value is not a threshold effects value and the actual threshold is unknown.

PAH data in sediments are somewhat limited spatially. Data are available for both media at upstream and downstream locations with periodic sampling throughout most of the drainage, however, some large reaches of the drainage have never been sampled introducing low to moderate uncertainty into the risk characterization. Since all samples were less than the LOEC, risks to the aquatic community assessment endpoint are likely to be low. Risks between the two sampling locations in McKay ditch are uncertain. PAHs were not detected in the two surface water samples available and were not identified as ECOPCs. No risks are predicted from exposure to surface water.

5.2.2 Risk Description of the MK AEU

ECOPCs were identified for both surface water and sediment within the MK AEU. The previous sections presented a chemical-based risk estimation using several LOEs. The MK AEU has been studied by others in order to define the aquatic ecological setting. The results from these studies were compiled to formulate the other/drainage lines of evidence (Attachment 7). The combination of the risk estimation and the other/drainage LOEs are used to provide the risk description and complete the risk characterization for this AEU.

This risk characterization begins with a site ecological setting description to provide perspective regarding the aquatic ecosystem characteristics associated with the MK AEU. The chemical risk LOEs and the other/drainage LOEs are then described, followed by the weight-of-evidence conclusions for the aquatic assessment endpoints.

Ecosystem Data

Several studies have been conducted which characterize historical and more current ecological conditions in the McKay Ditch (MK) AEU. Pertinent conclusions from these studies are provided here while more detailed summarizations are provided in

Attachment 7. However, only one study has assessed the aquatic communities and populations within the MK AEU since 1991.

Aquatic Community Studies

The MK AEU is located in the northeastern buffer zone (BZ) on RFETS. McKay Ditch is the major aquatic feature within this AEU and is a tributary to Walnut Creek. The ditch runs from west to east across the northern BZ and is hydrologically isolated from the Industrial Area (IA). McKay Ditch is used by the City of Broomfield to carry water from either Coal Creek or the South Boulder Diversion Canal (both west of RFETS) to the Great Western Reservoir, where it is stored by the City of Broomfield for irrigation. McKay Ditch is ephemeral and is generally dry. Flows in the ditch historically occur in the spring when the City of Broomfield is able to exercise its water rights and divert water into the ditch, or when overland runoff is captured and transported by the ditch. Future flows in McKay Ditch are expected to be similar to past flows because site accelerated actions do not impact the configuration of the ditch and operations are managed by the City of Broomfield.

The fish community within McKay Ditch has been surveyed once (K-H 1999) and no fish were recovered during that event. No studies have been completed of the benthic community that may inhabit this ditch. The limited information on the aquatic community within the MK AEU stems from the fact that it is typically dry most of the year. As noted in K-H (2002) "seasonal drought limits the species richness for fish and limits the development of the aquatic ecosystem in general in this semi-arid locale."

Waterfowl and Wading Birds

DOE (1996) did not evaluate risks to aquatic feeding birds within the McKay Ditch drainage, however, the risk assessments performed on the Walnut and Woman Creek drainages provides a tool for determining the potential for risk to wading birds and waterfowl that may utilize the aquatic habitats in the MK AEU, although those habitats are very limited in MK AEU.

The previous risk assessment identified Aroclor-1254, mercury, di-n-butylphthalate and antimony as potential risk drivers in the Walnut and Woman Creek drainages. PCBs were determined to be risk drivers for the heron and mallard based on exposure to sediments and from PCBs that had accumulated in the food chain. PCBs were not detected in MK AEU sediments. No significant risks were predicted for the heron or mallard in NW AEU, SW AEU or WC AEU (CRA Volume 15B1) with PCB concentrations in sediment at concentrations considerably higher than any expected in MK AEU. Therefore, no risks to the heron or mallard receptors are predicted in the MK AEU.

Antimony was also selected as an ECOPC for the heron receptor in the Woman Creek drainage. Exposure via sediments at maximum concentrations (51.3 mg/kg) was not expected to cause risk. The MDC in MK AEU is equal to 12.4 mg/kg. Therefore, no risks are expected to the heron or mallard receptors in the MK AEU.

Mercury was determined to be an ECOPC for the heron receptor in the Walnut Drainage based on exposure to mercury in fish that were predicted to have bioaccumulated mercury present in sediments. Again, no significant risks were expected with maximum sediment concentrations equal to 1.6 mg/kg. The MDC for mercury in sediments in MK AEU was equal to 0.16 mg/kg indicating that risks from exposure to mercury are also likely to be low.

Finally, di-n-butylphthalate was identified as an ECOPC in DOE (1996) for the mallard receptor due to exposure in surface water. Di-n-butylpthalate was not detected in MK AEU surface waters and risks are, therefore, expected to be low.

There is moderate uncertainty in these conclusions since habitat types and presence of potential ECOPCs in MK AEU are different than those identified in Walnut and Woman creeks. If concentrations of ECOPCs in MK AEU other than those identified in the drainages assessed in the previous risk assessment are elevated above those found in NW AEU, SW AEU and WC AEU, then risks are unknown for those chemicals. In addition, habitat in MK AEU is very different from habitats present in NW AEU, SW AUE and WC AEU. Perennial streams and ponds are not present in MK AEU indicating that exposure to either receptor is likely to be much lower than found in the drainages discussed in DOE (1996). Less exposure indicates that risks are likely to be lower, especially when ECOPC concentrations are similar or low. Risks are, therefore, expected to be low for the ECOPCs identified in DOE (1996) as the risk drivers for these receptors.

5.2.3 Uncertainty Analysis

General uncertainties applicable to RC AEU, MK AEU, NN AEU and SE AEU are discussed in Section 6. Uncertainties specific to the lines of evidence presented in the previous sections are discussed where appropriate within each section.

5.2.4 Risk Conclusions

Multiple LOEs were gathered to evaluate the aquatic risk conditions within the MK AEU. An evaluation of the contaminant risk potential was conducted using a standard HQ approach using both the surface water and sediment datasets from the MK AEU and from the background data set. Additional LOEs gathered from ecosystem and aquatic population studies as well as site-specific toxicity testing and results of previous risk assessments were also applied as appropriate. These LOEs were used to formulate risk-based conclusions for the MK AEU.

Aquatic Community Endpoint

<u>ECOPCs in Both Surface Water and Sediment</u>

Aluminum was identified as an ECOPC in both sediment and surface water. Sediment NOEC HQs were greater than 1 but LOEC HQs were less than 1 using the UTL as the EPCs. As discussed in Section 5.1, when the NOEC HQs are greater than 1 and the LOEC HQs are less than or equal to 1 the likelihood of risks to the aquatic community assessment endpoint is low. Therefore, risks to the MK AEU community of aquatic receptors from exposure to aluminum are likely to be low.

This conclusion is supported both by evaluation of surface sediments and in the evaluation of individual sample points. HQs calculated using surface sediment (0 – 6 in.) data resulted in equal or lower HQs than those calculated using the entire dataset. Evaluation of individual sample points indicated that no samples had detections that exceeded the LOEC.

For surface water, chronic AWQCs were exceeded by aluminum concentrations. Acute AWQCs were not available. The range of aluminum (total) concentrations appears to be very similar to the range of aluminum (total) concentrations in background. Aluminum toxicity in surface water is complex and the chronic AWQC is based on guidance that is not entirely appropriate for surface waters of Colorado. The EPA and the State of Colorado have recognized that total aluminum measurements often measure nontoxic clay fractions in surface water and that the true EPC would fall between the dissolved and total fraction concentrations. Therefore, CDPHE recently indicated that the acute criterion (0.750 mg/L) should be used instead of the chronic value when pH is greater than 6.9 and hardness is greater than 50 ppm, [CO basic standards work group, October 8, 2004]. Because pH and water hardness in the WC AEU meet these requirements, the acute criterion was considered the appropriate chronic AWQC for evaluation of aluminum toxicity. Overall, site-related risks from exposure to aluminum in surface water are likely to be low.

ECOPCs in Sediments Only

Chromium, fluoride, nickel, selenium and PAHs were identified as ECOPCs in sediment but not in surface water. All of these ECOPCs had HQs greater than 1 using the NOEC ESL, but only antimony, fluoride and selenium had LOEC-based HQs greater than 1.

Based on the criteria discussed in Section 5.0, this indicates that risks to the community of aquatic receptors in the WC AEU from exposure to chromium and nickel are likely to be low.

Risks are also likely to be low to the community of aquatic receptors from exposure to PAHs in sediment. As discussed in Section 5.1.2 the total exposure to and potential risk from PAHs may be more relevant at RFETS than consideration of risks from individual PAHs since the PAHs present in the environmental media at the site are not likely to be from a specific sources of individual PAHs but rather from mixed historical sources of PAH mixtures. All LOEC HQs for individual PAHs were less than 1 and the LOEC-based HQ based on total exposure of aquatic organisms to a mixture of PAHs found in the environment was less than 1 indicating that risks to populations of aquatic organisms from total PAH exposure is likely to be low.

Fluoride and selenium had LOEC HQs greater than 1. Fluoride was only sampled from one location at the headwaters of an ephemeral drainage of North Walnut Creek that lies adjacent to the IA in MK AEU. The sample exceeded both the NOEC and the LOEC. This location also was the only location at which selenium was detected above the NOEC concentration. The LOEC for selenium is also exceeded at that location. In general, the lack of LOEC exceedances in aquatic habitats with even intermittent flow indicates that risks to the aquatic community assessment endpoint are likely to be low for selenium and uncertain for fluoride.

The limited data that are available indicate that risks to the aquatic community assessment endpoint from fluoride in sediments are low. Selenium risks are also likely to be low.

The chemical risk characterization, therefore, indicates that low risk is predicted for all of the sediment-only ECOPCs in MK AEU with potential uncertainties related to the spatial coverage of the fluoride data.

ECOPCs in Surface Water Only

Cadmium (dissolved), iron (total) and zinc (dissolved) were identified as ECOPCs in surface water, but not in sediments. All three ECOPCs had chronic HQs greater than one, ranging from 3.7 for zinc (dissolved) to 19 for cadmium (dissolved). Both cadmium (dissolved) and zinc (dissolved) had acute HQs greater than one. No acute AWQC was available for iron.

Cadmium (dissolved) and zinc (dissolved) both had chronic HQs in background that were less than 1. The hardness-dependant AWQCs in the background dataset were, however, significantly higher than those used for the MK AEU due to a much lower total hardness calculated in the MK AEU. Iron (total) data in background exceed the chronic AWQC by a factor of more than 10 in 9 samples and the MK AEU dataset is completely within the range of iron (total) concentrations detected in site-specific background.

Iron (total) was the only ECOPC was data available after 1999. One sample exceeded the chronic AWQC while one was lower. The lack of current data represents a source of uncertainty related to current risks in the MK AEU

Risks from iron (total) and zinc are likely to be low. For iron (total) site-related risks are very similar to those predicted in background samples. Exceedances of the iron (total) chronic AWQC were observed at the western boundary of RFETS upstream of all potential RFETS-related historical sources. Zinc (dissolved) was detected above the chronic AWQC only at one location that it outside of any quality aquatic habitat in the MK AEU.

Cadmium risks are more uncertain. Chronic AWQCs were exceeded at 2 locations within McKay Ditch while the acute criterion was exceeded at one location. Current risks are uncertain due to a lack of data since 1999. Proxy values for non-detected samples are also greater than the chronic AWQC in a majority of samples indicating uncertainties in the ability of those samples to predict the lack of chronic risks. Finally, uncertainties related to the lack of quality aquatic habitat and the potential effects on risk to aquatic life in MK AEU should also be considered. That the fact that the ditch is dry most of the year is a significant factor influencing establishment of an aquatic community.

Pond-Specific Risks

No ponded areas are present in MK AEU. All surface water bodies are ephemeral or intermittent and the main water conveyance in the AEU, McKay Ditch, is a man-made structure designed to move water around potential source areas at RFETS. No pond-specific evaluation is required in MK AEU.

Waterfowl and Wading Birds

Risk is likely to be low for waterfowl and wading birds in the MK AEU. Previous risk assessments (DOE 1996) in the Walnut and Woman Creek drainages indicated that antimony, PCBs (Aroclor 1254), mercury and di-n-butylphthalate were the primary risk drivers in for semi-aquatic wildlife at RFETS. The risk assessment provided risk-based sediment criteria for both receptors for PCBs that were based on site-specific food tissue and sediment concentrations. A NOAEL TRV was used as the toxicity basis for the sediment criteria. PCBs were not detected in MK AEU sediments indicating that risks to the waterfowl and wading bird assessment endpoints are likely to be low. Similarly, antimony, mercury and di-n-butylphthalate concentrations are not likely to be indicative of population level risk since they are lower than concentrations shown in other AEUs to be below a level of concern. There is moderate uncertainty in the waterfowl risk since study conclusions for Walnut and Woman Creek drainages were used to infer potential risks within MK AEU. Exposure in MK AEU is expected to be lower than exposure assessed in DOE (1996) due to a lack of permanent water bodies in MK AEU.

5.2.5 MK AEU Summary

Risks to the aquatic community within the MK AEU are expected to be low (Table 5.6) for most ECOPCs. Low percentages of exceedances of LOEC-based sediment values indicate that most of the area of the MK AEU is associated with low risk for all of the sediment ECOPCs.

Surface water data provide a less certain indication of risk. Relatively high percentages of samples exceed the chronic ESLs for several surface water ECOPCs, particularly cadmium (dissolved). Cadmium (dissolved) data are limited temporally and have a majority of proxy values for non-detected samples that are greater than the chronic AWQC, limiting the ability to predict chronic risks. A single drainage located immediately adjacent to the IA and most likely part of the North Walnut drainage tends to frequently have the highest HQ exceedances observed in the MK AEU.

The distribution of aluminum and iron concentrations in MK AEU surface water closely match the background data distribution indicating that concentrations in the MK AEU may be representative of background conditions. Zinc concentrations only exceed the AWQCs in areas of limited aquatic habitat. There are uncertainties associated with the results for surface water risk characterization for ammonia including the lack of current data. Overall, the low percentage of exceedance of chronic and acute AWQC values does not suggest significant risk from surface water.

Data are available for both media at upstream and downstream locations with periodic sampling throughout most of the drainage, however, some large reaches of the drainage have never been sampled introducing low to moderate uncertainty into the risk characterization.

All surface water bodies within MK AEU are either ephemeral or intermittent. Aquatic communities in that area are, therefore, likely to be limited primarily based on the availability of consistent water sources. In addition, the nature of the primary waterbodies in the MK AEU are designed to convey water around any RFETS-related water. The factors should be carefully considered when making risk management decisions based on surface water and sediment chemical data. Even though risks cannot be completely ruled out for many of the ECOPCs, widespread effects to the aquatic community assessment endpoint in the MK AEU are not expected. Conclusions for MK AEU are summarized in Table 5.6.

5.3 No Name Gulch AEU Risk Characterization

Multiple ECOPCs in both sediment and surface water were identified for the NN AEU in Section 2. NN AEU contains several IHSS that could have historically impacted surface water and sediment quality, including the Present Landfill. All chemical groups from which ECOPCs were identified may be present in surface water and/or sediment due to historical sources at RFETs. Professional judgment was not used to eliminate any ECOIs from further consideration as ECOPCs.

The following sections provide the chemical-specific risk evaluation and a description of the risk to populations of aquatic receptors in the AEU based on the combination of the risk description, uncertainty analysis and all other applicable LOEs.

5.3.1 Chemical Risk Estimation for the NN AEU

Ammonia (un-ionized), barium (total), lead (dissolved), selenium (dissolved), silver (dissolved), zinc (dissolved), bis(2-ethylhexyl)phthalate, di-n-butylphthalate, Phenanthrene and phenol were identified as surface water ECOPCs for the NN AEU. Table 5.7 presents the HQ results for the surface water ECOPCs. Table 5.8 presents the HQ results for the post-1999 surface water dataset.

Similarly, Table 5.9 presents the HQ results for the sediment ECOPCs in the NN AEU. Inorganic ECOPCs for sediment include aluminum, barium, iron and lead. Organic ECOPCs in sediment include benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, chrysene, indeno(1,2,3-cd)pyrene, phenanthrene and pyrene. Total PAHs were also identified as an ECOPC for sediments. Table 5.10 presents the HQ results for the ECOPCs in surface sediment (0-6”).

Many ECOPCs for which risks are assessed in the CRA are naturally occurring constituents in the soils, sediments and surface waters at RFETS. Since the focus of the CRA is evaluating risks associated with residual site-related contamination following accelerated actions, it is important to calculate the risks that would be predicted at naturally occurring concentrations using the same assumptions and models as used in the

CRA. Risks calculated using background data can provide additional information on the magnitude of potentially site-related risks. Hazard quotients for aquatic receptors at background EPCs are presented in Table 5.13 for surface water and 5.14 for sediments. In addition, some anthropogenic organic chemicals may also have been released from historic IHSSs at the site. While these may also be found in uncontaminated areas, no background comparison was conducted for organic ECOPCs.

Aluminum

Aluminum was identified as an ECOPC in sediment in the NN AEU. Surface water concentrations were not significantly greater than background concentrations and aluminum was, therefore, eliminated from further consideration as an ECOPC in NN AEU surface water.

In sediments, NOEC concentrations are slightly exceeded both by the AEU-wide EPC and in 45 percent of individual samples (all HQs < 5). The LOEC is not exceeded by either the AEU-wide UTL or in individual samples. All of the samples that exceeded the NOEC were representative of surface sediments. Background aluminum data show a similar distribution.

Spatial evaluations indicate consistent exceedances of the sediment NOEC and that the majority of the exceedances were observed within the remediated East Landfill Pond (ELP). Two additional samples had HQs greater than one. One sample was located in the ephemeral drainage south of the ELP and one sample was collected just downstream of the pond (Figure 5.20).

Concentrations in surface soils adjacent to surface water bodies in NN AEU (Attachment 6) were also compared to the NOEC and LOEC ESLs. The MDC in surface soils adjacent to waterbodies in NN AEU was greater than the NOEC but less than the LOEC. The arithmetic mean concentration was less than both values.

Given the lack of LOEC exceedances in sediments, risks to the aquatic community assessment endpoint is likely to be low on an AEU-wide basis. All samples within the ELP were less than the LOEC and risks are likely to be low.

The sediment dataset for aluminum is somewhat spatially limited within No Name Gulch. However, data are available from both upstream and downstream sampling locations. Data within the ELP are adequate spatially and representative of post-remediation conditions. Aluminum was detected in all samples indicating that there are no data uncertainties related to detection limits.

Overall, site-related risks to the aquatic community assessment endpoint from aluminum exposure in sediment are likely to be low.

Ammonia

Ammonia (un-ionized) was identified as an ECOPC in surface water in the NN AEU. Only three samples were available. Two samples were collected from the ELP outfall while one sample was collected just upgradient of the ELP. Only the sample collected upgradient of the ELP (collected in 2002) exceeded the chronic AWQC. Ammonia was not detected in either sample from the ELP outfall (collected in 1992 and 1995), however, not enough data were available to determine a potential temporal trend. No background surface water data were available for ammonia. Ammonia data are shown organized by collection date on Figure 5.21. Sediment data were not available.

Ammonia is typically not a risk driver in sediments, but can have deleterious effects on the aquatic community endpoint in surface waters. No sediment data were available, thus introducing uncertainty into the analysis, but risks are considered unlikely from ammonia. The ammonia dataset in surface water, in terms of number of samples, is small and limited to the ELP. No samples were available from No Name Gulch. Proxy values for non-detected samples appear to be of sufficient quality to limit uncertainties related to non-detected samples.

Overall, site-related risks to the aquatic community assessment endpoint from ammonia exposure, in and near the ELP, from surface water are unknown due to the small amount of data available. Limitations in the spatial and temporal coverage of data introduce moderate to high uncertainties into the current risks due to ammonia and the risks within NN AEU.

Barium

Barium was identified as an ECOPC in both surface water and sediment in the NN AEU. Surface water concentrations did not exceed the chronic AWQC when it was adjusted for site-specific water hardness (Attachment 5). Risks due to barium exposure in surface water are expected to be low in NN AEU (Figure 5.24).

In sediments, NOEC concentrations are exceeded both by the AEU-wide EPC and in 40 percent of individual samples (all HQs < 5). The LOEC HQ is equal to one for the AEU 95^{th} UTL. Three samples exceed the LOEC by a factor of less than 5. Two samples exceeded the NOEC while none exceeded the LOEC in background samples.

Spatial evaluations indicate that the majority of the exceedances of the sediment NOEC were observed within the remediated East Landfill Pond (ELP). One additional sample had and HQ greater than one at the fist sample location downstream of the ELP (Figure 5.25). The three LOEC exceedances were all within the ELP and have HQs equal to 1 (Figure 5.26).

Concentrations in surface soils adjacent to surface water bodies in NN AEU (Attachment 6) were also compared to the NOEC and LOEC ESLs. The MDC in surface soils adjacent to waterbodies in NN AEU was less than both the NOEC and LOEC.

According to the criteria presented in Section 5.0, LOEC HQs equal to or less than 1 are indicative of low risks to the aquatic community assessment endpoint. Risks in NN AEU in general and in the ELP from exposure to barium in sediments are, therefore, expected to be low.

Iron

Iron was identified as an ECOPC in sediment in the NN AEU. Surface water concentrations were not significantly greater than background concentrations and iron was, therefore, eliminated from further consideration as an ECOPC in NN AEU surface water.

In sediments, NOEC concentrations are slightly exceeded both by the AEU-wide EPC and in 10 percent of individual samples in which iron was detected (all HQs < 5). The LOEC is not exceeded by either the AEU-wide UTL or in individual samples. All of the samples that exceeded the NOEC were representative of surface sediments. Background iron data show a similar distribution.

Spatial evaluations indicate two sample locations with concentrations in excess of the NOEC just downstream of the ELP. No other sampling locations exceeded the NOEC (Figure 5.27).

Concentrations in surface soils adjacent to surface water bodies in NN AEU (Attachment 6) were also compared to the NOEC and LOEC ESLs. The MDC in surface soils adjacent to waterbodies in NN AEU was less than both the NOEC and LOEC values.

Given the lack of LOEC exceedances in sediments, risks to the aquatic community assessment endpoint is likely to be low on an AEU-wide basis. All samples within the ELP were less than the LOEC and risks are likely to be low.

The sediment dataset for iron is somewhat spatially limited within No Name Gulch. However, data are available from both upstream and downstream sampling locations. Data within the ELP are adequate spatially and representative of post-remediation conditions. Iron was detected in all samples indicating there are no data uncertainties related to detection limits.

Overall, site-related risks to the aquatic community assessment endpoint from iron exposure in sediment are likely to be low.

Lead

Lead was identified as an ECOPC in both surface water and sediment in the NN AEU. Surface water concentrations did not exceed the chronic AWQC when it was adjusted for site-specific water hardness (Attachment 5). Risks due to lead exposure in surface water are expected to be low in NN AEU (Figure 5.29).

In sediments, NOEC concentrations are slightly exceeded both by the AEU-wide EPC and in one individual sample. The LOEC HQ is less than one for the AEU 95^{th} UTL. No samples exceeded either the NOEC or the LOEC in background samples.

Spatial evaluations indicate that the single NOEC exceedance was observed within an ephemeral drainage south of the ELP prior to its confluence with No Name Gulch (Figure 5.30).

Concentrations in surface soils adjacent to surface water bodies in NN AEU (Attachment 6) were also compared to the NOEC and LOEC ESLs. The MDC in surface soils adjacent to waterbodies in NN AEU was greater than the NOEC but less than the LOEC. The arithmetic mean concentration of adjacent surface soil was lower than both the NOEC and LOEC.

Given the lack of LOEC exceedances and the single, marginal, NOEC exceedance, risks from exposure to lead in sediments are likely to be low both the in entire AEU and in the ELP.

Selenium

Selenium (dissolved) was identified as an ECOPC in surface water in the NN AEU. The MDC for sediment was lower than the NOEC ESL and selenium was, therefore, removed from further consideration as an ECOPC. The AEU-wide EPC was greater than the chronic AWQC but less than the acute AWQC. Surface water was detected at concentrations that exceeded chronic AWQC in the NN AEU in 9 percent of samples. The acute AWQC for selenium (dissolved) was exceeded in one sample. NN AEU surface water UTL concentrations were higher than background UTL concentration. Selenium was detected in two percent of background surface water samples that exceeded the chronic AWQC while the acute AWQC was not exceeded in the background dataset.

Selenium was not detected in the single sample collected since 1999 (Figure 5.31) and the proxy value was lower than the chronic AWQC. Spatial evaluations of surface water are provided on Figures 5.32 and 5.33. The chronic AWQC was exceeded in three samples, once at each of three locations, once at a location at the outfall of the ELP, one location just downstream from the outfall and at one location in the ephemeral drainage to the south of the ELP. No samples were available in the downstream portion of No Name Gulch.

Overall, site-related risks to the aquatic community assessment endpoint from selenium exposure in surface water are expected to be low. Chronic and acute exceedances were detected prior to 1993 in only 2 samples (only 1 greater than the acute). In all samples collected since then, selenium has been detected only once (at a concentration greater than the chronic AWQC). The proxy values for all non-detected samples are lower than both the chronic and acute AWQCs indicating that the uncertainty based on non-detected samples is low. Uncertainties in the risk characterization for selenium are low to moderate include a small number of current data and no data in the downstream portions of the drainage.

Silver

Silver (dissolved) was identified as an ECOPC in surface water in the NN AEU. The MDC for sediment was lower than the NOEC ESL and silver was, therefore, removed from further consideration as an ECOPC.

The surface water AEU-wide EPC was greater than the chronic AWQC but less than the acute AWQC. Surface water was detected at concentrations that exceeded the chronic

AWQC in the NN AEU in 16 percent of samples. The acute AWQC for silver (dissolved) was exceeded in one sample. Neither the acute nor the chronic AWQC was exceeded in the background dataset, however, the AWQCs were considerably higher for the background dataset due to the higher total hardness in that dataset.

Silver was not detected in the single sample collected since 1999 (Figure 5.34). Spatial evaluations of surface water are provided on Figures 5.35 and 5.36. The chronic AWQC was exceeded at four locations, once upgradient of the ELP, once within the ELP, once at a location at the outfall of the ELP, one location just downstream from the outfall and at one location in the ephemeral drainage to the south of the ELP. No samples were available in the downstream portion of No Name Gulch. The acute AWQC was exceeded at one location just downstream of the ELP outfall.

Overall, site-related risks to the aquatic community assessment endpoint from silver exposure in surface water are expected to be low to moderate. Chronic and acute exceedances were detected prior to 1999. In the single sample collected since 1999, silver was not detected. Moderate uncertainty is introduced into the risk characterization since the proxy values for the majority of non-detected samples are higher than the chronic AWQC. Other uncertainties in the risk characterization for silver include a small number of current data and no data in the downstream portions of the drainage.

Zinc

Zinc (dissolved) was identified as an ECOPC in surface water in the NN AEU. The MDC for sediment was lower than the NOEC ESL and zinc was, therefore, removed from further consideration as an ECOPC.

The surface water AEU-wide EPC was greater than the chronic and acute AWQCs. For zinc at the site-specific hardness used for NN AEU, the chronic and acute AWQCs for zinc are essentially equal. Surface water zinc was detected at concentrations that exceeded both AWQCs in the NN AEU in 29 percent of samples. Zinc UTL concentrations in NN AEU are higher than the UTL concentrations in background, However, neither the acute nor the chronic AWQC was exceeded in the background dataset, however, the background-specific AWQCs were considerably higher than the AEU-specific AWQCs due to the higher total hardness in that dataset.

There appears to be a downward trend with time in the 1991 through 1999 zinc data (Figure 5.37). Zinc was detected in the single sample collected since 1999 at a concentration less than the chronic AWQC. Spatial evaluations of surface water are provided on Figures 5.35 and 5.36. The chronic AWQC was exceeded at four locations, once upgradient of the ELP, once within the ELP, once at a location at the outfall of the ELP, one location just downstream from the outfall and at one location in the ephemeral drainage to the south of the ELP. No samples were available in the downstream portion of No Name Gulch. The acute AWQC was exceeded at one location just downstream of the ELP outfall.

Overall, site-related risks to the aquatic community assessment endpoint from zinc exposure in surface water are expected to be low since the chronic AWQC has not been exceeded in any sample since 1993. In the single sample collected since 1999, zinc was detected at a concentration less than the chronic AWQC. Data trends indicate decreasing concentrations from 1991 through 1999 and the no increase was noted in the single post-199 sample. All non-detected samples had proxy values that were lower than the chronic AWQC indicating that uncertainty is low in regards to non-detected samples. Uncertainties in the risk characterization for zinc include a small number of current data and no data in the downstream portions of the drainage.

Bis(2-ethylhexyl)phthalate

Bis(2-ethylhexyl)phthalate was identified as an ECOPC in surface water in the NN AEU. The MDC for sediment was lower than the NOEC ESL and bis(2-ethylhexyl)phthalate was, therefore, removed from further consideration as an ECOPC.

The surface water AEU-wide EPC was slightly greater than the chronic AWQC but less than the acute value. One sample, collected from within the ELP had a detected concentration of bis(2-ethylhexyl)phthalate greater than the chronic AWQC but not the acute AWQC (Figure 5.40). Spatial evaluations of surface water are provided on Figure 5.41. The chronic AWQC was exceeded within the ELP from a sample collected in 1997, prior to the removal of pond sediments in 2005. However, it is unclear whether sediments were the source of the ECOPC in surface water. No samples were available in the downstream portion of No Name Gulch.

Overall, site-related risks to the aquatic community assessment endpoint from bis(2-ethylhexly)phthalate exposure in surface water are expected to be low. One chronic exceedance was observed in 1997 and the acute criterion has never been exceeded. In the two samples collected since 1999, bis(2-ethylhexyl)phthalate was not detected indicating a downward trend in the data, albeit based on a limited dataset. All non-detected samples had proxy values that were lower than the chronic AWQC indicating that uncertainty is low in regards to non-detected samples. There are high uncertainties in the risk characterization for bis(2-ethylhexyl)phthalate for current risk and risks in the downstream portions of the drainage due to limited available data.

Di-n-butylphthalate

Di-n-butylphthalate was identified as an ECOPC in surface water in the NN AEU. The MDC for sediment was lower than the NOEC ESL and di-n-butylphthalate was, therefore, removed from further consideration as an ECOPC.

The surface water AEU-wide EPC was greater than the chronic AWQC but less than the acute value. One sample, collected from within the ELP had a detected concentration of di-n-butylphthalate greater than the chronic AWQC but not the acute AWQC (Figure 5.42). Spatial evaluations of surface water are provided on Figure 5.43. The chronic AWQC was exceeded within the ELP from a sample collected in 1997, prior to the removal of pond sediments in 2005. However, it is unclear whether sediments were the source of the ECOPC in surface water. No samples were available in the downstream portion of No Name Gulch.

Overall, site-related risks to the aquatic community assessment endpoint from di-n-butylphthalate exposure in surface water are expected to be low. One chronic exceedance was observed in 1997 and the acute criterion has never been exceeded. In the two samples collected since 1999, di-n-butylphthalate was not detected indicating a downward trend in the data, albeit based on a limited dataset. All non-detected samples had proxy values that were lower than the chronic AWQC indicating that uncertainty is low in regards to non-detected samples. There are high uncertainties in the risk characterization for di-n-butylphthalate for current risk and risks in the downstream portions of the drainage due to limited available data.

Phenol

Phenol was identified as an ECOPC in surface water in the NN AEU. Phenol was not detected in NN AEU sediments, therefore, it was not selected as an ECOI for the AEU.

The surface water AEU-wide EPC was greater than the chronic AWQC but less than the acute value. One sample, collected from within the ELP had a detected concentration of phenol greater than the chronic AWQC but not the acute AWQC (Figure 5.44). Spatial evaluations of surface water are provided on Figure 5.45. The chronic AWQC was exceeded within the ELP from a sample collected in 1997, prior to the removal of pond sediments in 2005. However, it is unclear whether sediments were the source of the ECOPC in surface water. No samples were available in the downstream portion of No Name Gulch.

Overall, site-related risks to the aquatic community assessment endpoint from phenol exposure in surface water are expected to be low. One chronic exceedance was observed in 1997 and the acute criteria has never been exceeded. In the two samples collected since 1999, phenol was detected in one sample but did not exceed the chronic AWQC. All non-detected samples had proxy values that were lower than the chronic AWQC indicating that uncertainty is low in regards to non-detected samples. There are high uncertainties in the risk characterization for phenol for current risk and risks in the downstream portions of the drainage due to limited available data.

Phenanthrene

Phenanthrene was identified as an ECOPC in surface water in the NN AEU. Phenanthrene was also selected as an ECOPC in NN AEU sediments, however, potential sediment risks are discussed in the total PAH section.

The surface water AEU-wide EPC was greater than the chronic AWQC but less than the acute value. Six samples, collected from one location upstream of the ELP had detected concentrations of phenanthrene greater than the chronic AWQC but not the acute AWQC (Figure 5.46). Spatial evaluations of surface water are provided on Figure 5.47. The chronic AWQC was exceeded upstream of the ELP in samples collected in 1991, 1992, 1993 and 2002, prior to the removal of pond sediments in 2005. However, it is unclear whether sediments were the source of the ECOPC in surface water. Proxy values for all non-detected samples were also greater than the chronic AWQC. No samples were available in the downstream portion of No Name Gulch.

Chronic exceedances from one location were observed upstream of the ELP where all samples were non-detects. In the two samples collected since 1999, phenanthrene was detected in one sample in excess of the chronic AWQC. All non-detected samples had proxy values that were greater than or equal to the chronic AWQC indicating a moderate source of uncertainty in the risk characterization related to the ability of non-detected samples to assess risk to the chronic AWQC. Risks related to the acute AWQC are likely to be low. There are high uncertainties in the risk characterization for phenanthrene for current risk and risks in the downstream portions of the drainage due to limited available data.

Polycyclic-aromatic Hydrocarbons (PAHs)

Seven individual PAHs were identified as ECOPCs in NN AEU sediments. These included:

- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(g,h,i)perylene
- Chrysene
- Indeno(1,2,3-cd)pyrene
- Phenanthrene
- Pyrene

Distributions of hazard quotients are presented on Table 5.8 and spatial distributions of individual PAHs in sediment are presented on Figures 5.48 through 5.54. Detected concentrations exceeded the NOEC for each individual PAH, but none exceeded a LOEC.

PAHs are a class of compounds with over 100 different members. In the environment, PAHs are usually present as a mixture of these individual chemicals. Because all PAHs are believed to act on the same tissues through a common mechanism of toxicity, it is normally appropriate to evaluate risks from PAHs based on the total risk rather than the risk from each of the individual compounds.

There are two approaches which can be used to calculate total risks from PAHs. One approach calculates the total PAH concentration by summing concentrations of individual PAHs. This total PAH concentration is then compared to a toxicity benchmark that is based on total PAHs. The CRA Methodology selected the total PAH sediment toxicity benchmarks from MacDonald et al. (2000a), which derived consensus-based toxicity values after a review of data from multiple studies. Because of this, there is relatively high confidence in the ability of these toxicity benchmarks to predict potential risks to benthic invertebrate receptors from direct contact with sediment. However, one potential limitation of this approach is that it is assumed that the composition of the PAH mixture in site sediments is generally similar to the composition of the PAH mixtures in the sediments used to derive the toxicity benchmark. If the composition of the PAH mixture at the site is substantially different, potential risks could be either overestimated or underestimated, depending upon the types of differences between the PAH mixtures.

The other approach for estimating the total risk from PAHs is to compute the HQ for each individual PAH based on a toxicity benchmark that is specific to that chemical, and then sum the HQs. The benefit of this approach is that it accounts for differences in the composition and concentrations of individual PAHs in site sediments. However, there is lower confidence in this approach because the sediment toxicity benchmarks for individual PAHs have low confidence, and are usually too stringent. This is because the benchmarks for individual PAHs are generally derived from field-based toxicity tests in which all of the observed toxicity is ascribed to the concentration of each PAH, even though other PAHs and other chemicals in the sediment likely contributed to the observed toxicity. As a result, the total HQ for PAHs derived by this approach is likely to overestimate the true total risk.

For these reasons, for the purposes of this risk characterization summary, the focus will be on total PAH HQs derived using the total PAH benchmarks, rather than the sum of individual PAH HQs.

PAH concentrations were summed for each sediment sample (Attachment 6). For non-detected PAHs, one-half of the reported value was used as a proxy for that PAH in the sample. The PAH (total) concentrations were then compared to NOEC and LOEC concentrations for total PAH exposure that were developed as consensus TEC and PEC values by MacDonald et al. (2000a).

The NN AEU UTL concentration for PAH (total) in sediment was greater than the NOEC but less than the LOEC.

Since the reported value of non-detected PAHs can play a large role in the total concentration of PAH (total) in sediment, the total detected PAH concentration was also calculated for each sample (Attachment 6). The NOEC was exceeded in 44 percent of samples, however, all proxy values for non-detected samples were also greater than the NOEC. All total PAH values (detected or non-detected) are lower than the LOEC.

Spatially, the results presented on Figure 5.5 represent the total PAH concentrations from all depth fractions collected within the sediment column, however, in NN AEU only surface sediment data were available. The 95th UTL was greater than the NOEC but less than the LOEC. Six samples within the ELP and one sample just downstream of the outfall exceeded the NOEC but not the LOEC.

An evaluation of the PAH concentrations in surface soils that lie adjacent to the potential aquatic habitats in the NN AEU is also provided to represent a potential future scenario. Maximum concentrations of all detected PAHs were lower than their respective NOEC ESLs.

The PAH dataset is large and spatially adequate. Proxy values in non-detected samples were elevated above the NOEC in all non-detected samples but were less than the LOEC in all samples. This introduces a low degree of uncertainty into the risk characterization and conclusions of risk for PAHs.

Total PAHs were not detected at concentrations above the LOEC in any sample and the 95th UTL concentration for NN AEU was also lower than the LOEC. Therefore, risks to the aquatic community assessment endpoint due to exposure to sediments are expected to be low. The proxy values for non-detected samples are adequate to support this conclusion.

5.3.2 Risk Description of the NN AEU

ECOPCs were identified for both surface water and sediment within the NN AEU. The previous sections presented a chemical-based risk estimation using several LOEs. The NN AEU has been studied by others in order to define the aquatic ecological setting. The results from these studies were compiled to formulate the other/drainage lines of evidence (Attachment 7). The combination of the risk estimation and the other/drainage LOEs are used to provide the risk description and complete the risk characterization for this AEU.

This risk characterization begins with a site ecological setting description to provide perspective regarding the aquatic ecosystem characteristics associated with the NN AEU. The chemical risk LOEs and the other/drainage LOEs are then described, followed by the weight-of-evidence conclusions for the aquatic assessment endpoints.

Ecosystem Data

Aquatic biological data have only been collected once from sites in the NN AEU. Conclusions from this study are provided here while more detailed summarizations are provided in Attachment 7. Aquatic features within NN AEU include No Name Gulch, (a tributary to Walnut Creek) and the East Landfill Pond. Although No Name Gulch is downgradient from the East Landfill Pond, the flow-through discharge from the pond is typically not sufficient to generate flow for a significant distance down No Name Gulch. Run-off and seep flows from the watershed typically occur only in the wettest part of the year (March – May). As a result, flows are intermittent and the stream is usually dry the remainder of the year. Hence, the hydrologic connection between the East Landfill Pond and the remainder of No Name Gulch is limited.

Ebasco (1992) collected benthic organisms from the East Landfill Pond in the fall of 1991. Taxa observed in samples collected from this pond included oligochaetes, dipteran larvae, and fingernail clams. A total of 8 different taxa were reported for this location. The number of taxa collected from this pond was within the range of taxa (but on the low end) reported from other RFETS ponds sampled during this investigation (Ebasco 1992). Organisms recovered from this pond are often associated with stressful environments.

The lack of data for aquatic biota from No Name Gulch is likely due to the fact that the stream remains dry for large portions of the year; lack of flow in this stream is the primary factor limiting the development of an aquatic community in the stream. Little can be concluded from the one set of survey data collected from the pond other than the results are similar to results for a number of other RFETS ponds and that organisms tolerant of stressful conditions inhabit the East Landfill pond.

Waterfowl and Wading Birds

DOE (1996) did not evaluate risks to aquatic feeding birds within the No Name Gulch drainage, however, the risk assessments performed on the Walnut and Woman Creek drainages provides a tool for determining the potential for risk to wading birds and waterfowl that may utilize the aquatic habitats in the NN AEU, although those habitats are very limited in NN AEU.

The previous risk assessment identified Aroclor-1254, mercury, di-n-butylphthalate and antimony as potential risk drivers in the Walnut and Woman Creek drainages. PCBs were determined to be risk drivers for the heron and mallard based on exposure to sediments and from PCBs that had accumulated in the food chain. PCBs were not detected in NN AEU sediments. No significant risks were predicted for the heron or mallard in NW AEU, SW AEU or WC AEU (CRA Volume 15B1) with PCB concentrations in sediment at concentrations considerably higher than any expected in NN AEU. Therefore, no risks to the heron or mallard receptors are predicted in the NN AEU.

Antimony was also selected as an ECOPC for the heron receptor in the Woman Creek drainage. Exposure via sediments at maximum concentrations (51.3 mg/kg) were not expected to cause risk. Antimony was not detected in the NN AEU, therefore, no risks are expected to the heron or mallard receptors in the MK AEU.

Mercury was determined to be an ECOPC for the heron receptor in the Walnut Drainage based on exposure to mercury in fish that were predicted to have bioaccumulated mercury present in sediments. Again, no significant risks were expected with maximum sediment concentrations equal to 1.6 mg/kg. The MDC for mercury in sediments in MK AEU was equal to 0.09 mg/kg indicating that risks from exposure to mercury are likely to be low.

Finally, di-n-butylphthalate was identified as an ECOPC in DOE (1996) for the mallard receptor due to exposure in surface water. Potential risks were predicted at a concentration equal to 2 ug/L in surface water due to potential bioconcentration from surface water. The MDC in NN AEU was greater than 2 ug/L, however, that sample was collected in 1997. All samples collected since 1997 have been non-detects. Current risks are, therefore, expected to be low.

There is moderate uncertainty in these conclusions since habitat types and presence of potential ECOPCs in NN AEU are different than those identified in Walnut and Woman creeks. If concentrations of ECOPCs in NN AEU other than those identified in the drainages assessed in the previous risk assessment are elevated above those found in NW AEU, SW AEU and WC AEU, then risks are unknown for those chemicals. In addition, habitat in NN AEU is different from habitats present in NW AEU, SW AUE and WC AEU. Perennial streams are not present in NN AEU. In addition, the ELP represents the only source of ponded water. Exposure to either receptor is likely to be lower than found in the drainages discussed in DOE (1996). Less exposure indicates that risks are likely to be lower, especially when ECOPC concentrations are similar or lower. Risks are, therefore, expected to be low for the ECOPCs identified in DOE (1996) as the risk drivers for these receptors.

5.3.3 Risk Conclusions

Aquatic Community Endpoint

ECOPCs in Both Surface Water and Sediment

Barium, lead and phenanthrene were identified as ECOPCs in both sediment and surface water. In surface water, all samples for barium and lead were less than the chronic AWQC calculated using the mean hardness value for NN AEU. Risks are, therefore, likely to be low for both barium and lead due to exposure to NN AEU surface waters.

Sediment NOEC HQs were greater or equal to than 1 for all three ECOPCs while LOEC HQs were equal to 1 for barium only using the UTL as the EPC. LOEC HQs were less than one for lead and phenanthrene. As discussed in Section 5.1, when the NOEC HQs are greater than 1 and the LOEC HQs are less than or equal to 1 the likelihood of risks to the aquatic community assessment endpoint is low. Therefore, risks to the NN AEU community of aquatic receptors from exposure to barium, lead, and phenanthrene in sediments are likely to be low.

For barium, six samples within the EPL exceeded the NOEC ESL. Three of those samples also exceeded the LOEC but by only a small margin resulting in HQs equal to 1. Risks to aquatic receptors within the ELP are, therefore, likely to be low.

This conclusion is supported both by evaluation of surface sediments and in the evaluation of individual sample points. HQs calculated using surface sediment (0 – 6 in.) data resulted in equal or lower HQs than those calculated using the entire dataset.

For phenanthrene in surface water, proxy values for non-detected samples were greater than the chronic, but not the acute AWQCs. In addition, all detected samples were also greater than the chronic AWQC but less than the acute AWQC. Six samples, collected from one location upstream of the ELP had detected concentrations of phenanthrene greater than the chronic AWQC. The chronic AWQC was exceeded upstream of the ELP in samples collected in 1991, 1992, 1993 and 2002, prior to the removal of pond sediments in 2005. No detections of phenanethrene were noted within the ELP or downstream in No Name Gulch. Overall risks are expected to be low with uncertainties based on non-detected concentrations for chronic risks.

ECOPCs in Sediments Only

Aluminum, lead and PAHs were identified as ECOPCs in sediment but not in surface water. All of these ECOPCs had HQs greater than 1 using the NOEC ESL, but none had LOEC-based HQs greater than 1 either compared to the AEU-wide UTL or in individual samples.

Based on the criteria discussed in Section 5.0, this indicates that risks to the community of aquatic receptors in the NN AEU from exposure to aluminum, lead or PAHs (either individual or total PAHs) are likely to be low.

ECOPCs in Surface Water Only

Ammonia (un-ionized), selenium (dissolved), silver (dissolved), zinc (dissolved), bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and phenol were identified as ECOPCs in surface water, but not in sediments. All ECOPCs had chronic HQs greater than one, ranging from 1.1 for antimony (un-ionized) to 3.7 for zinc (dissolved). Zinc (dissolved) was the only ECOPC that also had an acute HQ greater than one.

All of the ECOPCs had chronic HQs in background that were less than 1 (no background data were available for ammonia). The hardness-dependant AWQCs in the background dataset were, however, significantly higher than those used for the NN AEU due to a much lower total hardness calculated in the NN AEU.

All of the ECOPCs had at least one surface water sample available that was collected after 1999. Only phenol was detected in any of the samples, but at a concentration less than the chronic AWQC.

Risks from selenium (dissolved), zinc (dissolved), bis(2-ethylhexyl)phthalate, di-n-butylphthalate and phenol are likely to be low. Chronic AWQC exceedances are limited and proxy values are lower than the chronic AWQCs for all of the listed ECOPCs.

Proxy values for non-detected silver (dissolved) and phenanthrene samples were generally greater than the chronic, but not the acute AWQCs. No exceedances of the acute criteria were observed and overall risks are expected to be low with uncertainties based on non-detected concentrations for chronic risks.

Ammonia (un-ionized) data were limited to three samples from one location. Only one of the three samples had a detected concentration that exceeded the chronic, but not the acute AWQC so risks are likely to be low. They are, however, uncertain due to the limited dataset.

Pond-Specific Risks

The ELP within the NN AEU represents the best available aquatic habitat in the AEU because it provides a large area of persistent, year long habitat. Risks to sub-populations of aquatic receptors inhabiting the ELP are evaluated separately.

Barium was the only ECOPC in sediment that had concentrations in excess of the LOEC concentration in ELP sediments. The exceedances were, however, minor and all resulted in HQs equal to 1. Risks to the aquatic receptors potentially inhabiting the ELP are likely to be low from exposure to sediments.

Surface water ECOPCs exceeded the chronic AWQC for silver (dissolved), bis(2-ethylhexyl)phthalate, di-n-butylphthalate and phenol in at least one sample. No other ECOPCs exceeded the chronic or acute AWQCs in ELP surface waters in any sample. All exceedances of surface water criteria were observed in samples collected prior to the removal of sediments from the pond in 2005. Surface water samples have not been collected since the sediments were removed..

Ebasco (1992) collected benthic organisms from the East Land Fill Pond in the fall of 1991. Taxa observed in samples collected from this pond included oligochaetes, dipteran larvae, and fingernail clams. A total of 8 different taxa were reported for this location. The number of taxa collected from this pond was within the range of taxa (but on the low end) reported from other RFETS ponds sampled during this investigation (Ebasco 1992). Organisms recovered from this pond are often associated with stressful environments. Sediments were removed from the ELP in 2005. Current conditions within the pond are unknown.

Overall, risks within the ELP are likely to be low for both surface water and sediment.

5.3.4 Uncertainty Analysis

General uncertainties applicable to RC AEU, MK AEU, NN AEU and SE AEU are discussed in Section 6. Uncertainties specific to the lines of evidence presented in the previous sections are discussed where appropriate within each section.

5.3.5 NN AEU Summary

Risks to the aquatic community within the NN AEU are expected to be low (Table 5.11) for most ECOPCs. Low percentages of exceedances of LOEC-based sediment values indicate that most of the area of the NN AEU is associated with low risk for all of the sediment ECOPCs.

Surface water data also indicate that risks from most ECOPCs are likely to be low. Only selenium (dissolved), silver (dissolved) and zinc (dissolved) exceeded an acute AWQC. All zinc exceedances were observed in samples collected prior to 1999. More current data did not exceed chronic or acute AWQCs. Only one sample of both selenium (dissolved) and silver (dissolved) exceeded the acute AWQC in samples collected in 1995.

Exceedances of AWQCs are limited to older data in samples collected from the ELP. All sediment samples collected after removal of ELP sediments had LOEC HQs less than or equal to one (barium HQs equal one). Therefore, risks within the ELP are likely to be low.

Proxy values for non-detected results were also adequate to support the conclusions reached for all ECOPCs except silver (dissolved) and phenanthrene. Both of these ECOPCs had proxy values in excess of their respective chronic AWQC but less than their acute AWQCs. Some uncertainty is introduced into the risk characterization due to elevated proxy values for non-detected samples.

Spatial and temporal uncertainties were also noted in the NN AEU. Spatially, surface water data were not available for much of the drainage downstream of the ELP. Temporally, only a limited dataset was available after 1999. Additional uncertainties that should be considered in the risk management process is the lack of quality, perennial aquatic habitat outside of the ELP. No Name Gulch is an intermittent stream and is dry for much of the year. Conclusions for the NN AUE are summarized in Table 5.11.

5.4 Southeast Drainage AEU Risk Characterization

No ECOPCs in either surface water or sediment were identified using the ECOPC identification process (Section 2). SE AEU is not hydrologically connected to the IA. Only the Roadway Spraying PAC which may be associated with PAHs is within the drainage associated with SE AEU. No further chemical risk characterization for the aquatic community assessment endpoint is required.

5.4.1 Ecosystem Data

Several studies have been conducted which characterize historical and more current ecological conditions in the SE AEU. Pertinent conclusions from these studies are provided here while more detailed summarizations are provided in Attachment 7. These studies, which include assessments of aquatic communities and populations, have been conducted in ponds and streams within the SE AEU since 1991.

Aquatic Community Studies

The SE AEU is located within the buffer zone and is outside areas that were used for RFETS Operations. Most of the surface water flow within the SE AEU is through Smart Ditch, an irrigation ditch that includes 2 small ponds (ponds D-1 and D-2). This area receives no runoff from the Industrial Area (IA). The irrigation ditch is owned and operated by the Church Estate. The ditch runs from Rocky Flats Lake and supplies the two ponds which are used for irrigation. Smart Ditch is typically dry.

The investigations summarized below focus on the benthic and fish communities within the SE AEU. Characterizing the attributes of these two communities provides useful information concerning the quality and health of the aquatic system as a whole. In addition, characterizing the physical habitat provides an important understanding of the quality and quantity of habitat available for aquatic species to utilize. Samples were collected and evaluated to determine the benthic community composition and metrics such as species richness, density, and diversity were derived to provide insights on conditions within a given aquatic habitat that influences community structure. The results of fish surveys provide similar information on the physical, biological, and chemical conditions within a water body.

Benthic Community

The benthic community in the SE AEU was sampled in 1991, 1993, 1994, 1996, 1998, 1999, and 2001. Although both the D-series ponds and Smart Ditch were sampled several times, each study did not always sample each type of habitat, thus the data available are not consistent for each year. Although the studies differed in the habitats evaluated and locations sampled, the study results provided the following information on the benthic community within the SE AEU:

- Benthic communities from Ponds D-1 and D-2 were sampled to represent locations with no known contaminant input from RFETS. Ponds D-1 and D-2 exhibit a wide range of community characteristics including the second lowest (D-1) and highest (D-2) diversity values (DOE 1996).

- Results of sampling conducted in 1994 indicated that approximately 60% of the macroinvertebrates collected from pond D-2 were pollution intolerant (sensitive to pollution and shows no facility to tolerate the contamination under most circumstances) and 30% were faculatively intolerant (tolerance to pollutants under certain conditions). Several studies reported that pond D-2 had the highest diversity or second most diverse macroinvertebrate community of all the ponds on the RFETS.

- Studies noted that water levels within the D-series ponds fluctuated greatly due to water management activities associated with RFETS operations (the pond was dry in 1993). Organisms capable of adapting to changing physical conditions were associated with these ponds.

Fish Community

Although surveys of the fish community within the Walnut Creek pond and stream system were conducted on several occasions between 1991 and 2001, data from within the SE AEU are limited. The fact that Smart Ditch was typically dry for prolonged periods precluded sampling and/or made the timing of sample collection difficult. The results of these surveys, most often conducted as presence/absence surveys, found that:

- Fathead minnows were the only fish species collected from Ponds D-1 and D-2.

- Fathead minnows were also the only fish species collected from Smart Ditch; minnows from the ponds probably re-colonized the ditch.

- Studies noted that water levels within the D-series ponds fluctuated greatly due to water management activities associated with RFETS operations (the pond was dry in 1993). Organisms capable of adapting to changing physical conditions were associated with these ponds (K-H 2001)

As was the case for the investigations of the benthic community, the various studies concluded that the fish found within the SE AEU are consistent with those species that would be expected for similar habitats (narrow, intermittent stream and pool systems) in a semi –arid region. The community present within the ditch was limited prolonged dry periods. Several authors identified water management practices as a major factor controlling the presence/absence of fish within the SE AEU. It was noted that management of water levels within the D-series of ponds also impacted the macrophyte community which in turn would influence the diversity and richness of the fish community that a given pond could support.

Toxicity Tests

The toxicity of surface water and sediments within the SE AEU has not been assessed**.**

Tissue Studies

Analysis of fathead minnows collected from the D-series found no detectable concentrations of PCBS (Stiger 1994).

Pond-Specific Summaries

The D-series ponds at RFETS are used to store water for irrigation. These ponds have been sampled several times since 1991 in order to understand the aquatic community composition.

Pond D-1

- Samples collected from Pond D-1 often indicated that the macroinvertbrate community in this pond was usually one of the least diverse of the RFETS ponds and was dominated by tolerant species such as oligochaete worms.
- Fathead minnows are the only fish that have been collected from pond D-1.
- Stiger (1994) and DOE (1996) that PCBs were not detected in fathead minnows collected from this pond.
- The aquatic community associated with Pond D-1 is largely influenced by factors such as fluctuating water levels associated with irrigation.

Pond D-2

- Benthic taxa in pond D-2 are dominated by faculatively intolerant species.
- The macrovinvertebrate community in Pond D-2 is typically one of the most diverse communities among the ponds on the RFETS.
- Fathead minnows are the only fish that have been collected from pond D-2
- Stiger (1994) and DOE (1996) that PCBs were not detected in fathead minnows collected from this pond.
- The aquatic community associated with Pond D-2 is largely influenced by factors such as fluctuating water levels associated with irrigation.

Summary

A limited number of investigations have been conducted in the SE AEU between 1991 and 2001. The ponds are not impacted by IA operations. However, water levels within the ponds are managed as part of an irrigation system. Despite periodically going dry, Pond D-2 often exhibited the most diverse macroinvertebrate community on the RFETS. On the other hand, the macroinvertebrate community with Pond D-1 often exhibited relatively low diversity and was dominated by species tolerant of stressful conditions. These results suggest that some environmental stress is present and that factors such as size of the ponds and fluctuating water levels are potentially limiting the aquatic communities of these ponds (DOE 1996). As noted in K-H (2002) "seasonal drought limits the species richness for fish and limits the development of the aquatic ecosystem in general in this semi-arid locale."

5.4.2 Waterfowl and Wading Birds

DOE (1996) did not evaluate risks to aquatic feeding birds within the Southeast Drainage including the D-series ponds, however, the risk assessments performed on the Walnut and Woman Creek drainages provides a tool for determining the potential for risk to wading birds and waterfowl that may utilize the aquatic habitats in the SE AEU.

The previous risk assessment identified Aroclor-1254, mercury, di-n-butylphthalate and antimony as potential risk drivers in the Walnut and Woman Creek drainages. PCBs were determined to be risk drivers for the heron and mallard based on exposure to sediments and from PCBs that had accumulated in the food chain. PCB and d-n-butylphthalate data were not available for SE AEU, however, no historical source of PCB or phthalate contamination is known within the SE AEU drainage. Risks from these two chemicals in the SE AEU are unknown but are expected to be low.

Antimony was also selected as an ECOPC for the heron receptor in the Woman Creek drainage. Exposure via sediments at maximum concentrations (51.3 mg/kg) were not expected to cause risk. Antimony was not detected SE AEU with a maximum proxy value equal to 0.84 mg/kg. Therefore, no risks are expected to the heron or mallard receptors in the SE AEU.

Mercury was determined to be an ECOPC for the heron receptor in the Walnut Drainage based on exposure to mercury in fish that were predicted to have bioaccumulated mercury present in sediments. Again, no significant risks were expected with maximum sediment concentrations equal to 1.6 mg/kg. The MDC for mercury in sediments in SE AEU was equal to 0.08 mg/kg indicating that risks from exposure to mercury are likely to be low.

There is moderate uncertainty in these conclusions since habitat types and presence of potential ECOPCs in RC AEU are different than those identified in Walnut and Woman creeks. If concentrations of ECOPCs in the SE AEU other than those identified in the drainages assessed in the previous risk assessment are elevated above those found in NW AEU, SW AEU and WC AEU, then risks are unknown for those chemicals. Given the buffer zone nature of the SE AEU, little to no site-related contamination is expected in

RC AEU (Attachment 3) and the potential for underestimation of risks using the risk conclusions from DOE (1996) is low.

5.4.3 Uncertainty Analysis

General uncertainties applicable to RC AEU, MK AEU, NN AEU, and SE AEU are discussed in Section 6. Uncertainties specific to the lines of evidence presented in the previous sections are discussed where appropriate within each section above.

5.4.4 Risk Conclusions

Multiple LOEs were gathered to evaluate the aquatic risk conditions within the SE AEU. No ECOPCs were identified in SE AEU surface water or sediments indicating that site-related risks are likely to be low. Additional LOEs gathered from ecosystem and aquatic population studies as well and the results of previous risk assessments were also compiled. These LOEs were used to formulate risk-based conclusions for the SE AEU. Conclusions for SE AEU are summarized in Table 5.12.

6.0 UNCERTAINTY ANALYSIS

6.1 Uncertainties Associated With Data Adequacy and Quality

Attachments 2 and 3 of Volume 2 of Appendix A the RI/FS discuss the general data quality for the AEUs. Attachment 2 of this document presents the data quality assessment for the AEUs that are addressed in this volume related to this AEU. Those documents conclude that data of sufficient quality and quantity for ERA purposes were collected in surface water and sediment for each AEU. The data are not, however, without limitations. Those specific limitations are discussed in Volume 2 of Appendix A. Limited data sources introduce a source of uncertainty that may underestimate risk. This source of uncertainty is expected to be low since the primary chemicals expected to be of concern for the site have adequate data available for risk assessment.

Attachment 1 of this document presents limitations of the reported value for non-detected ECOIs and ECOIs with infrequent detections. Uncertainties are associated with non-detected ECOIs with reported values elevated above the ESL. While non-detected and infrequently detected ECOIs are not likely to be ECOPCs, their removal from further risk-based consideration when reported values are elevated above screening-level ESLs or effects-based LOEC criteria or chronic and acute AWQCs introduces a source of uncertainty into the risk assessment process. Risks are uncertain when reported values for non-detected samples are elevated above one or more of these criteria. While there is confidence that the appropriate set of ECOPCs has been identified in the ECOPC identification process, there is a possibility that an ECOI with a potential for risk has not been identified as an ECOPC. Elevated reported values for non-detected and infrequently detected ECOIs may serve to underestimate the overall risk in the AEU to an unknown, but likely low extent. Underestimation of risk due to elevated reported values for non-detected samples is less likely for those ECOIs detected in greater than five percent of total samples is less likely. Since any ECOI detected in greater than five percent of samples is subjected to a comparison of the 95th UTL EPC to the screening-level ESL, evaluation of and elevated reported values is included in the EPC versus ESL comparison. This limits non-detected sample based uncertainty for all ECOIs detected in greater than fiver percent of samples. A full comparison of reported values of non-detected and infrequently detected ECOIs is provided in Attachment 1 of this document. Elimination of ECOPCs with reported values for non-detected samples due to lack of detection or very low frequency of detection may serve to underestimate risk to an unknown degree.

6.2 Uncertainties Associated with the Ecological Contaminants of Potential Concern Identification Process

The ECOPC process was designed to focus the risk characterization on those chemicals that have the potential to be of concern in the AEU. This procedure included a comparison of MDCs to ESLs, a frequency of detection evaluation, a comparison to background, and an EPC screen against the ESL. Use of this ECOPC identification process serves to identify those ECOIs related to historic site operations of toxicological significance are retained for additional quantitative evaluation.

6.2.1 Uncertainties Associated with Exposure Assumptions

Exposure was quantified using generally conservative assumptions regarding the life history and behavioral parameters for this group of receptors. These parameters were used to estimate the amount of contact a receptor may have with contaminated media by various exposure routes. The following parameters were assumed as part of the exposure assessment:

- Aquatic receptors are exposed throughout their life cycle to ECOIs present within surface water and sediment within a given AEU; and
- Aquatic habitat is available year-round within a given AEU; therefore, receptors do not migrate to other areas (i.e., OU 3) in absence of suitable habitat and, thereby, integrate exposure elsewhere. Since most of the flowing aquatic systems are primarily limited by the availability of the consistent presence of surface water, this is a conservative assumption.

Finally, the relative bioavailability of ECOPCs in surface water and sediment can create uncertainty in the risk characterization process. Such uncertainty can affect the EPCs used to estimate bioavailable forms (for example, dissolved metal in solution) as well as the toxicity endpoints used to derive toxicity reference values. Surface water criteria for divalent metals, for example, are generally based on toxicity associated with the bioavailable forms, which is assumed to be represented by the contaminant in dissolved soluble form.

Bioavailability and ecotoxicity of environmental contaminants are integrally linked to their environmental concentrations and contaminant forms (EPA 1999). The toxicity of a contaminant is controlled by:

- Its environmental concentration;
- Its site-specific chemistry (especially its ionic solubility and speciation if a metal or metalloid);
- The physical matrix in which the contaminant is found; and
- The uptake pathway(s) into a target organism from its physical matrix.

Organic carbon in sediments binds nonpolar (non-ionic) organic contaminants to render them less bioavailable (Mahony et al. 1996). If the TOC in AEU sediments is higher than the 1% TOC assumed in the ESLs, then these ESLs will be more conservative than necessary to protect benthic organisms. Higher OC in sediments is derived from decomposition of leaves and organic matter, producing a dark spongy soil. Sediment accumulation areas in the ponds, streams (backwaters and pools), and marshy areas with emergent vegetation can produce TOC-rich sediment (>5%) and electrochemically-reduced sediments that will produce sulfide. Acid volatile sulfides (AVS) bind metals when the sediments are anaerobic (Ankley et al. 1996). Therefore, sulfide and TOC likely to be present in the soft sediments of low-energy microhabitats, including pond bottoms, may serve to detoxify metals and certain organic contaminants.

The EPCs calculated for surface water exposure using the entire surface water dataset also introduces uncertainty into the analysis. The full surface water dataset an EPC based on data collected from 1991 through 2005. The EPC calculated using the entire dataset may result in a calculated EPC that is no longer representative of conditions at the Site. Subsequently, EPCs were also calculated using only more recent data (1999 through 2005) and temporal trend figures were included in the analysis to reduce the uncertainty caused by using surface water data that are no longer representative of site conditions.

All of these factors helped determine the exposure matrix for organisms in the field. Because the interplay of these factors determines the site-specific bioavailability and, thus, the potential expression of ecologically relevant effects, predictions of toxicity based solely on total concentrations in various environmental media have questionable scientific validity (EPA 1999). Therefore, assessment of ecological risks and the potential adverse effects of a contaminant required an understanding of the exposure matrix that may lead to actual uptake by a receptor species. The overall effect of the uncertainties related to unknown bioavailability may overestimate or underestimate the calculated risks to an unknown degree.

6.2.2 Uncertainties Associated with Development of Ecological Screening Levels

ESLs are typically based on information gained from laboratory and other carefully controlled experimental exposures described in the literature. This information is then used to extrapolate conditions likely to exist in the natural environment. The laboratory information often does not provide adequate background for these extrapolations. Consequently, assessment factors are often used to compensate for the many uncertainties inherent in the extrapolation from laboratory effects data to effects in natural ecosystems

(Warren-Hicks and Moore 1998). Uncertainties can arise (Calabrese and Baldwin 1993) when extrapolations are made from:

- Acute to chronic endpoints;
- One life stage to an entire life cycle;
- Individual effects to effects at the population level or higher;
- One species to many species;
- Laboratory to field conditions;
- One to all exposure routes;
- Direct to indirect effects;
- One ecosystem to all ecosystems; and/or
- One location or time to others.

The net effect of these uncertainties may result in either an overestimation or underestimation of risk, depending on RFETS-specific conditions, the types of receptors included in the evaluation, and the particular ECOIs.

The CRA Methodology presents a set of guidelines for applying toxicity data to develop ESLs for the ECOIs and to minimize uncertainty related to the extrapolations listed above. No procedures for the identification of toxicity data and eventual development of ESLs, however, can eliminate the uncertainty inherent in the overall development process for ESLs and risks may be under- or over-estimated to an unknown extent. However, since ESLs are based on no-effect or threshold effect levels the potential for under-estimation is limited.

6.2.3 Uncertainties Associated with the Lack of Toxicity Data for Ecological Contaminants of Interest

Several ECOIs detected in the AEUs did not have adequate toxicity data available in the published literature for the derivation of ESLs (CRA Methodology). The ECOPC identification process identified ECOIs of uncertain toxicity for each AEU (Tables 6.1 and 6.2).

Several of these surface water ECOIs are not expected to pose a risk to aquatic organisms. Calcium, magnesium, potassium, and sodium are considered macronutrients or rock-forming elements, and are not generally considered toxic to aquatic life. Radionuclide ESLs are available for all detected individual radionuclides and, therefore, the lack of ESLs for gross alpha and gross beta activities is not expected to affect the ERA. The potential for risk from these ECOIs is uncertain, but is likely to be low.

Benthic macroinvertebrate sediment ESLs were not available for certain inorganic, organic and radionuclide chemicals. Of these chemicals, calcium, magnesium, potassium, and sodium are considered macronutrients or rock-forming elements, and are not generally considered toxic to aquatic life. Radionuclide ESLs are available for all detected individual radionuclides and, therefore, the lack of ESLs for gross alpha and gross beta activities is not expected to affect the ERA.

This evaluation focused upon the assessment of ECOPCs within surface water and sediment exposure media to aquatic receptors. ECOPCs associated with one media can transport to the other through various biological and physico-contaminant processes. It is possible that one medium can act as a source of contamination to another. Of particular interest and concern to aquatic receptors is the possible dissolution of sediment associated ECOPCs to surface water. Because there was a lack of available ESLs for certain sediment contaminants for which there were surface water ESLs, it is possible that potentially toxic sediment-related contaminants could have been overlooked, despite being identified as surface water ECOPCs. In order to address this potential data gap, an evaluation of sediment ECOIs that lack ESLs, but not surface water ESLs, was completed.

Tables 6.1 through 6.6 present the surface water and sediment ECOIs for AEUs discussed in Volume 15B1 that lacked ESLs and were identified as uncertainties. For many of these ECOIs, there was also a lack of surface water ESL information; therefore, these will remain contaminants of uncertain toxicity. Others had low frequencies of detection (less than 10 percent) in either surface water or sediment, occurred below background levels, were common elements with low toxicity and considered nontoxic, or were not identified as surface water ECOPCs as part of the screening process.

6.2.4 Uncertainties Associated with Eliminating Ecological Contaminants of Potential Concern Based on Professional Judgment

Professional judgment was not applied as part of the NN AEU and MK AEU ECOPC evaluation process. Therefore there is no uncertainty introduced as a result of this process for these AEUs.

ECOIs in the RC AEU and in the SE AEU were eliminated as ECOPCs based on professional judgment (Attachment 3). No sources of contaminants or patterns of release were identified in the AEUs, and the slightly elevated concentrations of these ECOIs in the AEUs were most likely due to natural variation. The weight of evidence supports the conclusion that concentrations of these ECOIs are likely to be naturally occurring or otherwise unrelated to historical RFETS operations and not due to site activities. Uncertainty associated with the exclusion of risk from these chemicals is low.

7.0 SUMMARY AND CONCLUSIONS

This section provides a summary of conclusions relating to risk to aquatic life, as well as a summary of risk conclusions for waterfowl and wading bird receptors.

7.1 Aquatic Receptors

Multiple lines-of-evidence were gathered to evaluate the aquatic risk conditions to water column organisms and benthic macroinvertebrates within the RC AEU, NN AEU, MK AEU, and SE AEU. An evaluation of the potential for risk from contaminants in sediment and surface water was conducted using a standard HQ approach as well as other contaminant risk lines of evidence. Additional lines-of-evidence gathered from other/drainage studies were also compiled with the contaminant risk evaluation in order to formulate a risk conclusion. Conservative values representing EPCs of the data (e.g., MDC and 95 UTL) were compared to applicable benchmark values in the chemical risk evaluation. In addition to these EPCs, data were evaluated on a point-by-point basis and mapped to identify the extent of potential risk.

Following an initial screen of contaminants and professional judgment evaluation, the potential for site-related risk was determined to be low for all contaminants in RC AEU and SE AEU. ECOPCs were, however identified in NN AEU and MK AEU and were further evaluated in the risk characterization.

The aquatic conditions within the AEUs, evaluated by other studies that are summarized here, indicate that these drainages are primarily limited by flow conditions and habitat. The aquatic life within the system is highly susceptible to changes in flow and, in turn, is represented as an opportunistic assemblage of aquatic invertebrates. No studies have indicated water or sediment quality is a controlling factor to the ecology, and species assemblages are generally comparable to reference areas.

Risks are likely to be low based on the results of the risk characterizations for both MK AEU and NN AEU. In both AEUs, sediment ECOPCs are less than LOEC concentrations at all but a small percentage of sampling locations. Risks from fluoride are uncertain in MK AEU. In the one available sample, fluoride had a concentration greater than both the NOEC and the LOEC.

In surface waters, risks were also likely to be low to moderate in both AEUs. Uncertainties were noted in both AEUs based on the availability of recent surface water data, primarily for several metals. In MK AEU, cadmium was identified as an ECOPC with chronic AWQC exceedances but no recent data from which current conditions could be evaluated. In NN AEU selenium, silver and zinc were also detected at concentrations greater than AWQCs in historical data but were lacking current data. The magnitude of exceedances of the chronic AWQCs and the generally small number of exceedances of the acute AWQCs indicate that risks are likely to be low for all ECOPCs in surface water in both AEUs.

While significant risks from exposure to ECOPCs in surface water are not expected, because of to uncertainties due to limitations in the data, further monitoring is recommended in order to determine whether ECOPCs with somewhat uncertain current risks are of greater ecological concern than currently indicated by the limited data available.

7.2 Waterfowl and Wading Birds

DOE (1996) did not evaluate risks to aquatic feeding birds within the drainages discussed in this Volume, however, the risk assessments performed on the Walnut and Woman Creek drainages provide a tool for determining the potential for risk to wading birds and waterfowl that may utilize the aquatic habitats within the drainages discussed in Volume 15B1.

In all cases, risks are expected to be low to waterfowl and wading birds in RC AEU, MK AEU, NN AEU and SE AEU. ECOPCs identified in previous risk assessments as being of low risk are either not-detected or present at lower concentrations in the AEUs discussed in this volume that those presents as being of low risk in the previous risk assessments on Walnut and Woman Creeks. There is, however, moderate uncertainty in this conclusion since DOE (1996) did not specifically address risks to waterfowl and wading birds in RC AEU, MK AEU, NN AEU or SE AEU. While risks are not expected based on the review of results discussed above, a potential for underestimation of risks exists if there are ECOPCs present in the AEUs discussed in this report that are present at concentrations greater than those evaluated in DOE (1996) for the Walnut and Woman creek drainages.

8.0 REFERENCES

Ankley, G.T., D.M. DiToro, D.J. Hansen, and W.J. Berry. 1996. Technical basis and proposal for deriving sediment quality criteria for metals. Environmental Toxicology and Chemistry. 15:2056-2066.

Aquatics Associates Inc., 2003. Results of the Aquatic Monitoring Program in Streams at the Rocky Flats Site, Golden, Colorado 2001-2002. Prepared for U.S. Department of Energy, Rocky Flats Field Office, Golden, Colorado.

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

Calabrese, E.J., and L.A. Baldwin, 1993. Performing Ecological Risk Assessments. Chelsea, Michigan.

Colorado Department of Public Health and Environment (CDPHE), 2005a. Colorado Department of Public Health and Environment Water Quality Control Commission. Regulation No. 31: The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31). March 22.

DOE, 1992. Final Historical Release Report for Rocky Flats Plant, Golden, Colorado. June.

DOE, 1996. Final Phase I RFI/RI Report. Woman Creek Priority Drainage, Operable Unit 5. Appendix N. Ecological Risk Assessment for Woman Creek and Walnut Creek Watersheds at the Rocky Flats Environmental Technology Site. RF/ER-96-0012. UN. Rev. 0.

DOE, 2004. Comprehensive Risk Assessment Sampling and Analysis Plan. Addendum 04-01. Rocky Flats Environmental Technology Site. April.

DOE, 2005. Final Comprehensive Risk Assessment Work Plan and Methodology. Rocky Flats Environmental Technology Site. Revision 1. September.

Ebasco Environmental Consultants, Inc. 1992. Baseline Biological Characterization of the Terrestrial and Aquatic Habitats at Rocky Flats Plant. Prepared for U.S. DOE, Rocky Flats Field Office, Golden, Colorado.

EG&G, 1995, Geochemical Characterization of Background Surface Soils: Background Soils Characterization Program, Rocky Flats Environmental Technology Site, Golden, Colorado.

EPA, 1985. Agency. *Ambient Water Quality Criteria for Ammonia*, (EPA 440/5-85-001). January.

EPA, 1997. Ecological Risk Assessment for Superfund: Process for Designing and Conducting Ecological Risk Assessments. Interim Final. Washington, D.C. July.

EPA, 1999. Integrated Approach to Assessing the Bioavailability and Toxicity of Metals in Surface Waters and Sediments. EPA-822-E-99-001. EPA Office of Water, Office of Research and Development, Washington, D.C.

K-H, 1999. Appendix B: 1998 Study of the Preble's Meadow Jumping Mouse at the Rocky Flats Environmental Technology Site. 1998 Annual Wildlife Survey Report for the Rocky Flats Environmental Technology Site. Kaiser-Hill Company, L.L.C., Rocky Flats Environmental Technology Site, Golden, Colorado.

Kaiser-Hill, 2001. 2000 Annual Wildlife Survey for the Rocky Flats Environmental Technology Site. Kaiser-Hill Company, L.L.C., Rocky Flats Environmental Technology Site, Golden, Colorado.

K-H, 2002. 2001 Annual Vegetation Report for the Rocky Flats Environmental Technology Site. Kaiser-Hill Company, L.L.C., Rocky Flats Environmental Technology Site, Golden, Colorado.

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger, 2000a. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Arch. Env. Contam. Toxicol. Vol 39, 20-31.

Mahony, J.D., D.M. Di Toro, A.M. Gonzalez, M.Curto, M. Dilg, L.D. De Rosa, and L.A. Sparrow. 1996. Partitioning of Metals to Sediment Organic Carbon. Environmental Toxicology and Chemistry: Vol. 15, No. 12, pp. 2187–2197.

MIDEQ, 2003. Rule 57: Water Quality Values. February.

Stiger, 1994. OU 3 Final RFI/RI – Appendix K. PCB Study: "Results of PCB Sediment and Tissue Sampling For Walnut and Woman Creek Drainages and Offsite Reservoirs – SGS-576-94."

USACE, 1994. Rocky Flats Plant Wetland Mapping and Resource Study (prepared for U.S. Department of Energy), U.S. Army Corps of Engineers, Omaha District, December.

USFWS, 2001. Integrated Natural Resources Management Plan, Environmental Assessment, and Finding of No Significant Impacts for the Rock Creek Reserve. May 2001.

USFWS, 2004. Rocky Flats National Wildlife Refuge, Final Comprehensive Conservation Plan and Environmental Impact Statement. U.S. Fish and Wildlife Service. September.

Warren-Hicks, W.J., and D.R.J. Moore, 1998. Uncertainty Analysis in Ecological Risk Assessment. SETAC Press, Pensacola, Florida.

Wright Water Engineers, Inc., 1994. Integrated Analysis of Habitat, Macroinvertebrate, Fish, Flow and Selected Water Quality Parameters in the Main Stem of Big Dry Creek

TABLES

Table ES.1
Surface Water ECOPCs by AEU

ECOPC	No Name	Rock Creek	McKay Ditch	Southeast
Inorganics				
Aluminum (T)			**x**	
Ammonia (T)	**x**			
Barium (T)	**x**			
Cadmium (D)			**x**	
Iron (T)			**x**	
Lead (D)	**x**			
Selenium (D)	**x**			
Silver (D)	**x**			
Zinc (D)	**x**		**x**	
Organics				
Bis(2-ethylhexyl)phthalate	**x**			
Di-n-butylphthalate	**x**			
Phenanthrene	**x**			
Phenol	**x**			
Total ECOPCs	**10**	**0**	**4**	**0**

T = Total metal.
D = Dissolved metal.
x - Indicates analyte is an ECOPC.

Table ES.2

Sediment ECOPCs by AEU

ECOPC	No Name	Rock Creek	McKay Ditch	Southeast
Inorganics				
Aluminum	x		x	
Barium	x			
Chromium			x	
Fluoride			x	
Iron	x			
Lead	x			
Nickel			x	
Selenium			x	
Organics				
Benzo(a)anthracene	x			
Benzo(a)pyrene	x			
Benzo(g,h,i)perylene	x			
Chrysene	x			
Indeno(123-cd)pyrene	x			
Phenanthrene	x			
Pyrene	x			
Total PAHs	x		x	
Total ECOPCs	**12**	**0**	**6**	**0**

x - Indicates analyte is an ECOPC.

Table 1.1
IHSS, PAC, UBC Site - AEU Locations

IHSS	IHSS Group	PAC/UBC Site	Operable Unit	AEU	Description
114	000-5	NW-114	BZ	NN	Present Landfill
166.1		NE-166.1	BZ	NN	Trench A
166.2		NE-166.2	BZ	NN	Trench B
166.3		NE-166.3	BZ	NN	Trench C
167.1		NE-167.1	BZ	MD, NN	Landfill North Area Spray Field
167.2		NE-167.2	BZ	NN	Pond Area Spray Field (Center Area)
167.3		NE-167.3	BZ	NN	South Area Spray Field
168		000-168	11	MD	West Spray Field
170		NW-170	BZ	NN	PU&D Storage Yard - Waste Spills
199		Offsite Area 1	3	N/A	Off-Site Area 1
200		Offsite Area 2	3	N/A	Great Western Reservoir
201		Offsite Area 3	3	N/A	Standley Lake
202		Offsite Area 4	3	N/A	Mower Reservoir
203		NW-203	BZ	NN	Inactive Hazardous Waste Storage Area
174A	NE/NW	NW-174A	BZ	NN	PU&D Yard Container Storage Area
174B		NW-174B	BZ	NN	PU&D Container Storage Facilities
N/A		100-604	BZ	MD	T130 Complex Sewer Line Leaks
N/A		NE-1400	BZ	MD	Tear Gas Powder Release
N/A		000-501	BZ	MD, NN, NW, RC, SE, SW, WC	Roadway Spraying (originally identified as 000-501 in HRR Qtly Update 4; reassigned as 100-613 in the HRR Qtly Update 7)
N/A		NW-1500	BZ	NN	Diesel Spill at PU&D Yard (originally identifed as NW-175 in HRR Quarterly Update No. 3; reassigned as NW-1500 in HRR Quarterly Update No. 7)
N/A	NE/NW	NW-1501	BZ	NN	Asbestos Release at PU&D Yard (originally identified as NW-176 in HRR Quarterly Update No. 3; reassigned as NW-1501 in HRR Quarterly Update No. 7)
N/A		NW-1502	BZ	NN	Improper Disposal of Diesel-Contaminated Material at Landfill (originally identifed as NW-177 in HRR Quarterly Update No. 2; reassigned as NW-1502 in HRR Quarterly Update No. 7)
N/A		NW-1503	BZ	NN	Improper Disposal of Fuel-Contaminated Material at Landfill
N/A		NW-1504	BZ	NN	Improper Disposal of Thorosilane-Contaminated Material at Landfill
N/A	NE-1	NW-1505	BZ	NN	North Firing Range

Table 1.2
Number of Samples Collected in Each AEU by Medium and Analyte Suite

AEU	Analyte Suite	Surface Water		Sediment
		Total	Dissolved	
MK AEU	Inorganics	40	27	12
	Organics	14	N/A	8
	Radionuclides	38	1	13
NN AEU	Inorganics	73	32	20
	Organics	60	N/A	16
	Radionuclides	74	14	23
RC AEU	Inorganics	110	42	22
	Organics	43	N/A	22
	Radionuclides	43	5	20
SE AEU	Inorganics	14	7	7
	Organics	7	N/A	N/A
	Radionuclides	11	2	9

N/A = Not available or applicable.

Table 1.3
Summary of Surface Water ECOI Data in the RC AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Inorganic (Dissolved) (mg/L)										
Arsenic	3	41	7.32	7.00E-04	-	0.00230	0.00160	0.00440	8.50E-04	6.64E-04
Cadmium	6	42	14.3	2.00E-04	-	0.00460	0.00140	0.00340	0.00142	7.55E-04
Chromium	3	41	7.32	2.00E-04	-	0.00550	0.00210	0.0154	0.00167	0.00228
Copper	21	42	50	0.00200	-	0.00920	0.00115	0.0215	0.00410	0.00493
Lead	12	41	29.3	1.00E-04	-	0.00250	1.20E-04	0.0121	0.00130	0.00224
Manganese	39	42	92.9	4.00E-04	-	0.00210	0.00120	0.486	0.0267	0.0773
Mercury	1	41	2.44	1.00E-04	-	2.00E-04	0.00477	0.00477	2.11E-04	7.30E-04
Nickel	3	42	7.14	0.00400	-	0.0332	0.00141	0.00730	0.00509	0.00317
Selenium	3	42	7.14	0.00100	-	0.00670	0.00150	0.00380	0.00110	8.45E-04
Silver	1	42	2.38	1.00E-04	-	0.00680	0.00200	0.00200	0.00139	6.92E-04
Thallium	1	40	2.50	1.00E-04	-	0.00380	4.30E-04	4.30E-04	9.57E-04	4.87E-04
Zinc	23	42	54.8	0.00170	-	0.0312	0.00240	0.0235	0.00699	0.00632
Inorganic (Total) (mg/L)										
Aluminum	98	109	89.9	0.0187	-	0.148	0.0183	129	5.12	15.2
Antimony	13	110	11.8	4.20E-04	-	0.0493	4.10E-04	0.00630	0.00581	0.00678
Barium	108	109	99.1	0.0889	-	0.0889	0.00260	0.630	0.0922	0.0747
Beryllium	27	109	24.8	2.00E-05	-	0.00170	3.00E-05	0.00370	4.15E-04	5.89E-04
Calcium	109	109	100		N/A		1.53	152	28.5	16.8
Cesium	4	44	9.09	1.20E-04	-	0.500	0.00560	0.0600	0.124	0.117
Chloride	92	98	93.9	0.200	-	5	0.990	76	13.0	10.8
Cobalt	34	109	31.2	1.50E-04	-	0.00730	2.60E-04	0.0193	0.00171	0.00251
Cyanide	2	34	5.88	0.00100	-	0.0200	0.00240	0.0260	0.00586	0.00491
Fluoride	94	98	95.9	0.100	-	0.330	0.100	1	0.374	0.162
Iron	107	109	98.2	0.0527	-	0.0717	0.0144	88.6	3.54	10.4
Lithium	79	102	77.5	0.00200	-	0.0209	0.00140	0.154	0.0106	0.0189
Magnesium	108	109	99.1	2.76	-	2.76	0.355	18.2	6.59	2.90
Molybdenum	41	102	40.2	3.30E-04	-	0.0171	4.50E-04	0.00840	0.00213	0.00171
Nitrate / Nitrite	26	40	65	0.0200	-	0.100	0.0600	2.07	0.489	0.519
Nitrite	1	32	3.13	0.0200	-	0.100	0.0580	0.0580	0.0193	0.0117
Ortho-phosphate	1	20	5	0.0200	-	0.0500	0.110	0.110	0.0285	0.0195
Phosphate	11	16	68.8	0.0100	-	0.0500	0.0200	0.0600	0.0253	0.0135
Phosphorus	9	27	33.3	0.0500	-	0.0500	0.0500	0.180	0.0485	0.0399
Potassium	102	109	93.6	1.06	-	3.33	0.370	15.4	2.42	2.09

Table 1.3
Summary of Surface Water ECOI Data in the RC AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Silica	3	3	100	N/A			19	21	20.3	1.15
Silicon	46	46	100	N/A			0.0640	177	13.6	26.9
Sodium	109	109	100	N/A			0.309	35	16.5	6.82
Strontium	101	102	99.0	0.0714	-	0.0714	0.00510	0.703	0.167	0.0860
Sulfate	97	98	99.0	0.500	-	0.500	1.32	258	29.1	26.1
Sulfide	2	33	6.06	1	-	1	6	16	1.14	2.83
Tin	10	99	10.1	5.20E-04	-	0.136	9.90E-04	0.0190	0.00608	0.0107
Titanium	1	3	33.3	0.00260	-	0.00260	0.0110	0.0110	0.00453	0.00560
Vanadium	66	109	60.6	0.00110	-	0.0202	3.80E-04	0.132	0.0105	0.0230
Organic (Total) (ug/L)										
Acetone	2	29	6.90	10	-	26	13	28	6.62	4.62
Chlorobenzene	1	43	2.33	0.500	-	5	0.400	0.400	2.04	0.909
Chlorodifluoromethane	3	3	100	N/A			2	3	2.33	0.577
Chloroform	2	43	4.65	0.500	-	5	0.200	0.200	2.03	0.920
Methylene Chloride	3	43	6.98	1	-	68	0.300	2	3.46	5.23
Tetrachloroethene	1	43	2.33	0.500	-	5	10	10	2.21	1.52
Radionuclide (Total) (pCi/L)										
Americium-241	37	37	100	N/A			-0.00400	0.127	0.00643	0.0209
Cesium-137	23	23	100	N/A			-0.558	0.890	0.165	0.374
Curium-244	1	1	100	N/A			0.00200	0.00200	0.00200	0
Gross Alpha	24	24	100	N/A			0.00800	45	5.34	12.4
Gross Beta	24	24	100	N/A			1.02	35	6.07	8.98
Neptunium-237	2	2	100	N/A			-0.00600	0.00900	0.00150	0.0106
Plutonium-239/240	35	35	100	N/A			-0.00300	1.69	0.0510	0.285
Radium-226	3	3	100	N/A			-0.100	4.90	2.30	2.51
Strontium-89/90	17	17	100	N/A			0.140	1.80	0.597	0.465
Thorium-230	1	1	100	N/A			0.220	0.220	0.220	0
Thorium-232	1	1	100	N/A			-0.0290	-0.0290	-0.0290	0
Tritium	27	27	100	N/A			-63	320	101	110
Uranium-233/234	29	29	100	N/A			-0.0560	5.10	1.02	1.37
Uranium-235	29	29	100	N/A			-0.00962	0.290	0.0611	0.0699
Uranium-238	29	29	100	N/A			0.0423	4.90	0.892	1.30

[a] Values in this column represent reported results for U-qualified data (i.e., nondetects)

[b] For organics and inorganics, statistics are computed using one-half the reported result for nondetects

[c] All radionuclide values are considered detects.

Table 1.4
Summary of Sediment ECOI Data in the RC AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Inorganic (mg/kg)										
Aluminum	22	22	100		N/A		2,380	19,500	11,300	4,784
Antimony	1	19	5.26	0.690	-	29.5	11.1	11.1	3.77	3.73
Arsenic	21	22	95.5	0.990	-	0.990	1.70	15	4.32	3.12
Barium	22	22	100		N/A		34.5	360	153	79.7
Beryllium	14	19	73.7	0.390	-	1.30	0.320	2.10	0.787	0.463
Boron	5	5	100		N/A		3.40	17	10.4	5.68
Cadmium	7	19	36.8	0.480	-	4	0.210	1.30	0.691	0.413
Calcium	22	22	100		N/A		1,970	61,000	9,089	12,198
Cesium	1	15	6.67	8	-	749	2.90	2.90	82.4	92.8
Chromium	21	22	95.5	1.90	-	1.90	4.20	28.2	12.3	6.17
Cobalt	20	21	95.2	0.950	-	0.950	2.60	18	7.67	4.29
Copper	20	22	90.9	10.2	-	18.2	5.80	29.9	14.3	6.50
Iron	22	22	100		N/A		2,520	39,000	15,529	8,352
Lead	22	22	100		N/A		5.90	79.1	22.9	16.0
Lithium	21	21	100		N/A		1.80	20.3	8.37	3.90
Magnesium	22	22	100		N/A		444	4,100	2,388	937
Manganese	22	22	100		N/A		35.8	2,500	357	517
Mercury	5	19	26.3	0.100	-	0.620	0.0130	0.0660	0.0875	0.0603
Molybdenum	4	20	20	0.230	-	9.70	0.310	9.60	1.89	2.50
Nickel	20	21	95.2	16.5	-	16.5	1.40	23	10.9	4.41
Nitrate / Nitrite	10	15	66.7	1.10	-	22.8	0.700	76	12.6	20.2
Potassium	21	21	100		N/A		342	2,900	1,499	616
Selenium	7	22	31.8	0.210	-	2.40	0.380	3.20	0.748	0.761
Silica	5	5	100		N/A		760	2,600	1,792	752
Silicon	11	11	100		N/A		128	1,480	486	438
Silver	4	19	21.1	0.110	-	5.40	1.20	3.40	0.918	0.914
Sodium	16	22	72.7	110	-	637	70.1	413	174	96.6
Strontium	22	22	100		N/A		9.50	179	49.7	36.1
Thallium	2	19	10.5	0.290	-	2.80	0.200	0.410	0.371	0.276
Tin	6	19	31.6	0.660	-	25	7.40	37.1	6.98	8.55

Table 1.4
Summary of Sediment ECOI Data in the RC AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Titanium	5	5	100		N/A		48	170	108	45.6
Uranium	2	5	40	1.20	-	2.20	5.10	7.80	3.05	3.25
Vanadium	22	22	100		N/A		6.40	57.1	28.1	11.4
Zinc	21	22	95.5	35.5	-	35.5	11.3	720	124	191
Organic (ug/kg)										
1,1,1-Trichloroethane	1	11	9.09	5	-	14	9	9	5.05	1.88
2-Butanone	2	13	15.4	10	-	29	20	190	24.7	49.8
4,6-Dinitro-2-methylphenol	1	17	5.88	1,700	-	13,000	1,100	1,100	2,444	1,399
4-Methylphenol	3	20	15.0	340	-	2,500	640	1,500	587	362
4-Nitrophenol	1	17	5.88	1,700	-	13,000	1,300	1,300	2,182	1,380
Acetone	4	11	36.4	10	-	190	46	520	110	161
Benzo(a)anthracene	1	19	5.26	330	-	2,500	62	62	503	312
Benzo(a)pyrene	1	18	5.56	330	-	2,500	130	130	521	309
Benzoic Acid	7	20	35	1,700	-	8,000	230	2,000	1,789	1,046
bis(2-ethylhexyl)phthalate	7	18	38.9	330	-	2,500	80	350	418	323
Chrysene	1	19	5.26	330	-	2,500	74	74	504	311
Di-n-butylphthalate	6	20	30.0	340	-	2,500	66	250	409	340
Fluoranthene	1	19	5.26	330	-	2,500	89	89	504	310
Methylene Chloride	1	15	6.67	8	-	63	300	300	31.4	74.8
Pentachlorophenol	1	19	5.26	1,700	-	13,000	1,500	1,500	2,329	1,368
Phenanthrene	1	19	5.26	330	-	2,500	59	59	503	312
Phenol	1	19	5.26	340	-	2,500	120	120	506	307
Pyrene	1	19	5.26	330	-	2,500	130	130	507	307
Tetrachloroethene	1	10	10	5	-	14	38	38	8	10.6
Toluene	1	10	10	5	-	14	39	39	8.10	10.9
Total PAHs	2	19	10.5	2,640	-	18,200	1,264	3,730	7,655	4,522
Trichloroethene	1	11	9.09	5	-	14	48	48	8.59	13.1
Xylene	1	10	10	5	-	14	14	14	5.60	3.27
Radionuclide (pCi/g)										
Americium-241	18	18	100		N/A		-0.00300	0.0376	0.00892	0.0104
Cesium-134	6	6	100		N/A		0.00200	0.260	0.0945	0.0870

Table 1.4
Summary of Sediment ECOI Data in the RC AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Cesium-137	15	15	100	N/A	0.103	1.50	0.444	0.407
Gross Alpha	15	15	100	N/A	1.20	62	27.8	18.2
Gross Beta	15	15	100	N/A	5.58	54	30.7	13.3
Plutonium-239/240	20	20	100	N/A	0	0.0810	0.0241	0.0245
Radium-226	9	9	100	N/A	0.750	1.80	1.18	0.359
Radium-228	9	9	100	N/A	0.810	4.10	1.98	1.02
Strontium-89/90	14	14	100	N/A	-0.0100	0.560	0.217	0.150
Uranium-233/234	18	18	100	N/A	0.425	2.30	1.37	0.568
Uranium-235	18	18	100	N/A	0.0190	0.269	0.0821	0.0756
Uranium-238	18	18	100	N/A	0.731	2.30	1.24	0.466

[a] Values in this column represent reported results for U-qualified data (i.e., nondetects).

[b] For organics and inorganics, statistics are computed using one-half the reported result for nondetects.

[c] All radionuclide values are considered detects.

Table 1.5
Summary of Surface Water ECOI Data in the MK AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Inorganic (Dissolved) (mg/L)										
Arsenic	3	24	12.5	7.00E-04	-	0.110	0.00145	0.00250	0.00762	0.0183
Cadmium	5	26	19.2	2.00E-04	-	0.00460	2.10E-04	0.00300	9.40E-04	8.10E-04
Chromium	10	26	38.5	0.00200	-	0.00600	8.30E-04	0.0244	0.00257	0.00450
Copper	17	24	70.8	0.00200	-	0.00960	0.00270	0.0250	0.00541	0.00470
Lead	14	25	56	7.00E-04	-	0.0530	3.90E-04	0.0708	0.00715	0.0158
Manganese	27	27	100		N/A		0.00134	0.316	0.0870	0.101
Nickel	10	26	38.5	0.00500	-	0.0200	0.00110	0.0131	0.00469	0.00296
Selenium	4	26	15.4	8.00E-04	-	0.0440	0.00100	0.00390	0.00374	0.00679
Silver	1	26	3.85	1.00E-04	-	0.00680	0.00230	0.00230	0.00106	0.00107
Thallium	2	26	7.69	1.00E-04	-	0.109	2.40E-04	0.00650	0.00702	0.0175
Zinc	22	26	84.6	0.00720	-	0.0101	0.00260	0.245	0.0371	0.0530
Inorganic (Total) (mg/L)										
Aluminum	39	39	100		N/A		0.0880	46	4.17	7.75
Antimony	1	39	2.56	4.40E-04	-	0.0500	0.00510	0.00510	0.0103	0.00887
Barium	35	39	89.7	0.0500	-	0.0500	0.00610	0.340	0.0928	0.0922
Boron	2	2	100		N/A		0.0190	0.0200	0.0195	7.07E-04
Calcium	39	39	100		N/A		2.70	110	20.9	23.1
Cerium	4	4	100		N/A		0.00202	0.0295	0.0182	0.0129
Cesium	6	26	23.1	1.00E-04	-	0.500	3.30E-04	0.0500	0.0920	0.118
Chloride	24	24	100		N/A		4.10	67	15.3	12.8
Cobalt	14	39	35.9	9.10E-04	-	0.00730	7.10E-04	0.0100	0.00234	0.00174
Fluoride	20	22	90.9	0.100	-	0.154	0.100	0.360	0.190	0.0826
Iron	38	38	100		N/A		0.0870	42	3.85	6.92
Lithium	13	30	43.3	0.00100	-	0.0140	0.00140	0.0210	0.00407	0.00424
Magnesium	39	39	100		N/A		0.715	23	4.79	4.60
Molybdenum	1	34	2.94	2.60E-04	-	0.0150	6.00E-04	6.00E-04	0.00239	0.00200
Nitrate / Nitrite	23	27	85.2	0.0500	-	0.100	0.120	2.20	0.684	0.561
Nitrite	1	10	10	0.0200	-	0.0500	0.0370	0.0370	0.0202	0.00951
Ortho-phosphate	1	6	16.7	0.0500	-	0.0500	0.580	0.580	0.118	0.227
Phosphate	5	5	100		N/A		0.0200	0.0600	0.0340	0.0167
Phosphorus	10	14	71.4	0.0500	-	0.0500	0.0300	0.180	0.0560	0.0425
Potassium	39	39	100		N/A		1.15	18	4.13	2.96
Silica	3	3	100		N/A		1.60	17	10.5	7.99
Silicon	31	31	100		N/A		2.60	60	9.30	10.7

Table 1.5
Summary of Surface Water ECOI Data in the MK AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Sodium	39	39	100		N/A		1.77	490	39.2	89.1
Strontium	31	32	96.9	0.00650	-	0.00650	0.0190	0.590	0.140	0.143
Sulfate	21	24	87.5	5	-	5	4.32	34.5	13.9	9.29
Tin	1	34	2.94	0.00100	-	0.0500	0.0280	0.0280	0.00743	0.00747
Titanium	2	2	100		N/A		0.00270	0.0350	0.0189	0.0228
Vanadium	20	39	51.3	0.00160	-	0.00650	6.80E-04	0.0820	0.00807	0.0143
Organic (Total) (ug/L)										
2-Butanone	1	12	8.33	10	-	10	3	3	4.83	0.577
bis(2-ethylhexyl)phthalat	1	2	50	10	-	10	1	1	3	2.83
Methylene Chloride	1	13	7.69	5	-	10	16	16	3.73	3.75
Tetrachloroethene	1	13	7.69	5	-	10	5	5	2.88	0.939
Trichloroethene	1	13	7.69	5	-	10	5	5	2.88	0.939
Radionuclide (Total) (pCi/L)										
Americium-241	36	36	100		N/A		-0.00100	0.0320	0.00798	0.00856
Cesium-137	7	7	100		N/A		-0.160	0.740	0.185	0.328
Gross Alpha	27	27	100		N/A		0.129	33	6.53	7.88
Gross Beta	29	29	100		N/A		1.68	60	13.0	12.2
Plutonium-238	8	8	100		N/A		-0.00189	0.0134	0.00509	0.00575
Plutonium-239/240	35	35	100		N/A		-0.00922	0.500	0.0265	0.0900
Radium-226	1	1	100		N/A		0.540	0.540	0.540	0
Strontium-89/90	6	6	100		N/A		0.300	2.10	0.978	0.679
Tritium	8	8	100		N/A		-120	751	87.6	276
Uranium-233/234	34	34	100		N/A		-0.0440	5.93	0.454	1.01
Uranium-235	34	34	100		N/A		-0.0390	0.190	0.0192	0.0403
Uranium-238	34	34	100		N/A		0	3.39	0.354	0.596

[a] Values in this column represent reported results for U-qualified data (i.e., nondetects).

[b] For organics and inorganics, statistics are computed using one-half the reported result for nondetects.

[c] All radionuclide values are considered detects.

Table 1.6
Summary of Sediment ECOI Data in the MK AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Inorganic (mg/kg)										
Aluminum	12	12	100		N/A		2,390	30,300	11,016	8,591
Antimony	1	12	8.33	0.540	-	14.1	12.4	12.4	3.04	3.76
Arsenic	12	12	100		N/A		1.40	8.40	3.47	2.29
Barium	12	12	100		N/A		18	170	77.2	54.5
Beryllium	10	12	83.3	0.260	-	0.540	0.260	1.50	0.571	0.415
Boron	4	4	100		N/A		1.40	6.40	3.38	2.40
Cadmium	5	12	41.7	0.260	-	1.46	0.0670	0.490	0.349	0.204
Calcium	12	12	100		N/A		470	130,000	15,173	37,063
Cesium	1	8	12.5	1.70	-	107	4.90	4.90	17.3	21.2
Chromium	12	12	100		N/A		2.10	44.3	12	12.1
Chromium VI	1	1	100		N/A		0.0130	0.0130	0.0130	0
Cobalt	11	12	91.7	8.20	-	8.20	1.90	9.30	4.68	2.18
Copper	11	12	91.7	4.70	-	4.70	3.10	33.2	11.5	10.1
Fluoride	1	1	100		N/A		8.47	8.47	8.47	0
Iron	12	12	100		N/A		4,200	27,500	11,686	7,438
Lead	12	12	100		N/A		2	73.6	14.8	20.0
Lithium	12	12	100		N/A		2.30	19.2	8.28	6.01
Magnesium	12	12	100		N/A		560	4,700	2,314	1,633
Manganese	12	12	100		N/A		67	326	165	86.4
Mercury	4	12	33.3	0.0600	-	0.243	0.0160	0.160	0.0691	0.0489
Molybdenum	7	12	58.3	1.20	-	7.28	0.190	2.40	1.24	1.06
Nickel	11	12	91.7	7.90	-	7.90	3.10	28.3	10.9	8.06
Nitrate / Nitrite	4	7	57.1	0.100	-	1.30	0.300	64	9.73	23.9
Potassium	12	12	100		N/A		423	2,940	1,356	891
Selenium	1	12	8.33	0.240	-	0.810	2.70	2.70	0.456	0.716
Silica	4	4	100		N/A		500	970	698	228
Silicon	3	3	100		N/A		252	854	463	339
Sodium	12	12	100		N/A		65.1	2,090	381	557
Strontium	12	12	100		N/A		4.10	180	34.1	48.0
Thallium	1	12	8.33	0.240	-	1.46	0.400	0.400	0.245	0.177
Tin	3	12	25	0.820	-	45.8	3.60	9.30	4.99	6.40
Titanium	4	4	100		N/A		62	150	97	41.5
Uranium	1	4	25	0.960	-	1.20	1.10	1.10	0.668	0.293

Table 1.6
Summary of Sediment ECOI Data in the MK AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Vanadium	12	12	100	N/A			7.40	67.7	25.5	18.4
Zinc	12	12	100	N/A			19	347	80.1	96.7
Organic (mg/kg)										
2-Butanone	1	8	12.5	10	-	27	3	3	7.06	3.05
4-Methylphenol	1	8	12.5	340	-	1,200	95	95	303	173
Benzoic Acid	1	7	14.3	1,700	-	5,600	480	480	1,369	814
bis(2-ethylhexyl)phthalate	3	8	37.5	390	-	1,200	52	120	315	232
Chrysene	1	8	12.5	340	-	1,200	150	150	310	164
Di-n-butylphthalate	3	8	37.5	390	-	1,200	38	280	289	197
Fluoranthene	2	8	25	340	-	1,200	88	170	291	180
Phenanthrene	1	8	12.5	340	-	1,200	96	96	303	172
Pyrene	2	8	25	340	-	1,200	61	170	288	184
Toluene	2	8	25	6	-	27	2	6	5	3.63
Total PAHs	2	8	25	2,720	-	9,600	3,789	5,926	5,327	2,476
Radionuclides (pCi/g)										
Americium-241	12	12	100	N/A			-0.0242	0.0869	0.0149	0.0280
Cesium-134	3	3	100	N/A			0.0870	0.200	0.132	0.0597
Cesium-137	7	7	100	N/A			0.00200	0.391	0.154	0.133
Gross Alpha	9	9	100	N/A			-2.40	79	35.3	27.5
Gross Beta	9	9	100	N/A			8.45	69	44.1	16.9
Plutonium-239/240	12	12	100	N/A			0.00169	0.0538	0.0241	0.0172
Radium-226	5	5	100	N/A			0.390	1.90	0.918	0.597
Radium-228	3	3	100	N/A			0.930	1.70	1.19	0.442
Strontium-89/90	7	7	100	N/A			0.0300	0.316	0.178	0.113
Uranium-233/234	12	12	100	N/A			0.303	15	2.25	4.11
Uranium-235	12	12	100	N/A			-0.0400	0.460	0.0905	0.128
Uranium-238	12	12	100	N/A			0.310	13	2.03	3.55

[a] Values in this column represent reported results for U-qualified data (i.e., nondetects).

[b] For organics and inorganics, statistics are computed using one-half the reported result for nondetects.

[c] All radionuclide values are considered detects.

Table 1.7
Summary of Surface Water ECOI Data in the NN AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Inorganic (Dissolved) (mg/L)										
Arsenic	11	30	36.7	5.80E-04	-	0.00260	6.50E-04	0.00240	0.00100	4.81E-04
Cadmium	1	32	3.13	8.00E-05	-	0.00460	0.00330	0.00330	0.00134	7.77E-04
Chromium	2	31	6.45	3.00E-04	-	0.0275	0.00360	0.00420	0.00213	0.00238
Copper	13	31	41.9	7.50E-04	-	0.00540	0.00240	0.0120	0.00358	0.00298
Lead	5	32	15.6	7.20E-04	-	0.00430	0.00100	0.00470	8.69E-04	8.71E-04
Manganese	24	29	82.8	0.00130	-	0.00250	0.00110	1.50	0.514	0.655
Nickel	8	31	25.8	0.00140	-	0.0193	0.00410	0.0246	0.00693	0.00500
Selenium	3	32	9.38	0.00100	-	0.00400	0.0109	0.0425	0.00289	0.00772
Silver	5	32	15.6	2.00E-04	-	0.00680	0.00370	0.0131	0.00258	0.00240
Zinc	23	31	74.2	0.00240	-	0.0135	0.00220	1.50	0.259	0.466
Inorganic (Total) (mg/L)										
Aluminum	48	56	85.7	0.0170	-	0.0474	0.0169	55.4	3.12	9.33
Ammonia	1	3	33.3	0.0300	-	0.100	1.50	1.50	0.522	0.847
Antimony	9	58	15.5	5.50E-04	-	0.0459	5.90E-04	0.0150	0.00732	0.00699
Barium	58	58	100		N/A		0.00290	0.820	0.252	0.194
Beryllium	14	57	24.6	2.00E-05	-	0.00100	3.00E-05	0.00250	3.97E-04	4.41E-04
Calcium	57	57	100		N/A		1.56	166	64.1	38.8
Cesium	0	25	0	0.0330	-	0.500	0	0	0.187	0.104
Chloride	28	29	96.6	0.200	-	0.200	5.60	286	112	81.7
Cobalt	21	58	36.2	1.50E-04	-	0.00800	1.60E-04	0.0123	0.00233	0.00260
Fluoride	27	28	96.4	0.100	-	0.100	0.290	0.950	0.578	0.202
Iron	57	57	100		N/A		0.0163	117	15.3	30.9
Lithium	47	49	95.9	0.00530	-	0.0138	0.00620	0.0976	0.0282	0.0266
Magnesium	57	57	100		N/A		0.354	54.6	24.3	15.6
Molybdenum	23	53	43.4	4.20E-04	-	0.0120	6.10E-04	0.0213	0.00316	0.00375
Nitrate / Nitrite	13	36	36.1	0.0200	-	0.200	0.0700	1.90	0.183	0.402
Nitrite	1	17	5.88	0.0200	-	0.0500	0.0310	0.0310	0.0130	0.00679
Phosphorus	7	16	43.8	0.0500	-	0.0500	0.0570	0.150	0.0617	0.0467
Potassium	54	57	94.7	0.726	-	3.88	1.23	13.5	5.35	3.23
Silicon	26	26	100		N/A		0.0760	18.3	5.67	4.23
Sodium	57	57	100		N/A		0.316	195	77.7	65.0

Table 1.7
Summary of Surface Water ECOI Data in the NN AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Strontium	53	53	100		N/A		0.00530	1.23	0.506	0.311
Sulfate	26	31	83.9	0.500	-	5	0.460	143	21.3	28.7
Tin	4	49	8.16	7.00E-04	-	0.0720	0.0179	0.0569	0.00805	0.0118
Vanadium	28	58	48.3	1.20E-04	-	0.0110	5.40E-04	0.0951	0.00785	0.0159
Organic (Total) (ug/L)										
1,1-Dichloroethane	9	53	17.0	0.200	-	5	4	10	2.54	2.58
1,2,4-Trichlorobenzene	1	35	2.86	0.100	-	12	3	3	2.21	2.21
1,2,4-Trimethylbenzene	1	22	4.55	0.100	-	1	2	2	0.493	0.368
1,2-Dichloroethene	2	31	6.45	5	-	5	4	4	2.60	0.375
1,2-Dichloropropane	2	53	3.77	0.100	-	5	0.480	0.960	1.68	1.02
2,4-Dimethylphenol	2	23	8.70	5	-	330	2	3	11.2	33.5
2-Methylnaphthalene	6	23	26.1	5	-	330	6.20	23	14.0	33.4
4-Bromophenyl-phenylether	1	22	4.55	5	-	330	3	3	11.8	34.2
4-Isopropyltoluene	1	22	4.55	0.200	-	1	3	3	0.543	0.566
4-Methylphenol	2	21	9.52	5	-	330	2	3	11.8	35.1
Acenaphthene	6	23	26.1	5	-	330	2.70	4	10.9	33.6
Acenaphthylene	1	22	4.55	5	-	330	2	2	11.7	34.3
Acetone	6	39	15.4	10	-	35	3.90	43	7.91	8.96
alpha-BHC	2	7	28.6	0.0500	-	0.0540	0	0.360	0.0696	0.128
Benzene	3	53	5.66	0.200	-	5	1	2	1.63	1.01
beta-BHC	2	7	28.6	0.0500	-	0.0540	0	0	0.0182	0.0125
bis(2-ethylhexyl)phthalate	9	22	40.9	9	-	12	0.400	34	5.81	6.78
Bromoform	1	53	1.89	0.500	-	5	0.100	0.100	1.68	1.03
Butylbenzylphthalate	1	22	4.55	5	-	330	0.700	0.700	11.7	34.3
Chlorodifluoromethane	3	3	100		N/A		4	68	25.3	37.0
Chloroethane	9	53	17.0	0.500	-	10	21	62	8.49	14.1
Chloromethane	1	53	1.89	0.500	-	10	7	7	3.25	2.28
delta-BHC	2	7	28.6	0.0500	-	0.0540	0	0.180	0.0439	0.0608
Dibenzofuran	5	23	21.7	5	-	330	1	2	10.7	33.7
Dichlorofluoromethane	1	1	100		N/A		16	16	16	0
Diethylphthalate	5	23	21.7	5	-	330	0.700	3	10.8	33.6
Di-n-butylphthalate	4	22	18.2	5	-	12	0.400	48	6.08	9.51

Table 1.7
Summary of Surface Water ECOI Data in the NN AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Ethylbenzene	9	53	17.0	0.200	-	5	9	17	3.67	5.06
Fluorene	6	23	26.1	5	-	330	2	3	10.8	33.6
gamma-BHC (Lindane)	2	7	28.6	0.0500	-	0.0540	0	0	0.0182	0.0125
Heptachlor	2	7	28.6	0.0500	-	0.0540	0	0	0.0182	0.0125
Isophorone	1	22	4.55	5	-	330	0.200	0.200	11.7	34.3
Methylene Chloride	15	53	28.3	1	-	18	0.0900	37	3.26	5.30
Naphthalene	9	36	25	0.200	-	11	1.50	25	4.92	7.14
Pentachlorophenol	1	23	4.35	25	-	1,700	4	4	57.8	173
Phenanthrene	6	23	26.1	5	-	330	3.50	6	11.3	33.5
Phenol	3	27	11.1	5	-	5,000	3.50	5,000	380	1,137
Pyrene	1	22	4.55	5	-	330	2	2	11.7	34.3
Toluene	9	53	17.0	0.200	-	5	8	47	5.78	11.6
Total PAHs	10	36	27.8	0.100	-	2,146	1.80	100	103	352
Trichloroethene	2	53	3.77	0.100	-	5	2	2	1.66	1.02
Vinyl Chloride	2	53	3.77	0.200	-	10	8	11	3.37	2.55
Xylene	9	47	19.1	0.500	-	5	9	24	4.45	6.18
Radionuclides (pCi/L)										
Americium-241	65	65	100	N/A			-0.0150	0.0330	0.00402	0.00871
Cesium-137	20	20	100	N/A			-0.607	1.20	0.221	0.462
Gross Alpha	25	25	100	N/A			-0.670	8.20	2.79	2.30
Gross Beta	26	26	100	N/A			3.07	20	9.92	3.05
Plutonium-238	5	5	100	N/A			-0.00181	0.0188	0.00662	0.00993
Plutonium-239/240	64	64	100	N/A			-0.00600	0.0560	0.00576	0.0110
Radium-226	2	2	100	N/A			0.130	0.230	0.180	0.0707
Strontium-89/90	15	15	100	N/A			0.600	4.06	1.33	0.869
Tritium	30	30	100	N/A			-131	1,500	214	278
Uranium-233/234	49	49	100	N/A			-0.0238	4.07	1.30	0.882
Uranium-235	49	49	100	N/A			-0.0120	0.338	0.0697	0.0684
Uranium-238	49	49	100	N/A			-0.0100	3.65	1.12	0.796

[a] Values in this column represent reported results for U-qualified data (i.e., nondetects).

[b] For organics and inorganics, statistics are computed using one-half the reported result for nondetects.

Table 1.7
Summary of Surface Water ECOI Data in the NN AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation

[c] All radionuclide values are considered detects.

Table 1.8
Summary of Sediment ECOI Data in the NN AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Inorganic (mg/kg)								
Aluminum	20	20	100	N/A	6,000	24,000	14,689	5,247
Arsenic	20	20	100	N/A	3.60	7.10	5.41	1.08
Barium	20	20	100	N/A	92.6	390	192	80.3
Beryllium	19	20	95	0.880 - 0.880	0.600	1.20	0.918	0.188
Boron	10	10	100	N/A	4.80	10	7.06	1.79
Cadmium	2	20	10	0.0560 - 1.20	0.110	0.160	0.251	0.215
Calcium	20	20	100	N/A	2,280	74,000	11,400	15,253
Cesium	1	8	12.5	13.5 - 129	3.90	3.90	36.8	25.4
Chromium	19	20	95	10 - 10	3.70	25	13.8	6.26
Cobalt	20	20	100	N/A	4.30	11.8	7.84	1.79
Copper	20	20	100	N/A	5.70	19.1	15.8	2.92
Iron	20	20	100	N/A	9,050	21,500	15,513	3,194
Lead	20	20	100	N/A	12	37.6	20.4	5.99
Lithium	17	18	94.4	7.10 - 7.10	4.30	15	9.40	3.03
Magnesium	20	20	100	N/A	1,200	4,200	3,003	756
Manganese	20	20	100	N/A	78	1,100	254	226
Mercury	11	20	55	0.0700 - 0.130	0.0170	0.0900	0.0508	0.0149
Molybdenum	11	18	61.1	1.40 - 2.60	0.260	5.20	0.947	1.10
Nickel	20	20	100	N/A	7	17	12.8	2.10
Nitrate / Nitrite	7	10	70	0.650 - 1.10	0.638	3.20	1.32	0.978
Potassium	19	20	95	821 - 821	989	2,810	1,640	618
Selenium	6	19	31.6	0.240 - 0.960	0.410	0.880	0.459	0.203
Silica	10	10	100	N/A	1,400	2,000	1,720	230
Silicon	6	6	100	N/A	153	417	267	95.6
Silver	1	20	5	0.0720 - 1.70	0.340	0.340	0.321	0.288
Sodium	17	20	85	41.1 - 109	38.1	600	148	128
Strontium	18	18	100	N/A	33.4	320	70.3	64.8
Thallium	9	20	45	0.270 - 0.700	0.310	2.30	0.443	0.497
Tin	5	18	27.8	1.80 - 47.5	7.70	16.6	5.57	6.53
Titanium	10	10	100	N/A	59	150	93.8	27.6

Table 1.8
Summary of Sediment ECOI Data in the NN AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration [b]	Standard Deviation
Vanadium	20	20	100	N/A			18.7	59	35.9	11.7
Zinc	20	20	100	N/A			29.1	110	64.1	17.3
Organic (ug/kg)										
1,2,4-Trimethylbenzene	6	10	60.0	5.80	-	6.50	1.40	4.60	2.87	0.994
2-Butanone	1	16	6.25	10	-	31	13	13	10.3	3.54
Acetone	10	16	62.5	11	-	83	6.10	99	22.9	23.2
Anthracene	2	16	12.5	340	-	510	37	51	187	60.6
Benzo(a)anthracene	6	16	37.5	340	-	870	42	150	220	146
Benzo(a)pyrene	2	16	12.5	340	-	1,000	98	160	316	131
Benzo(b)fluoranthene	4	16	25	340	-	1,000	56	190	278	145
Benzo(g,h,i)perylene	2	16	12.5	340	-	1,000	71	89	310	140
Benzo(k)fluoranthene	1	16	6.25	340	-	1,000	110	110	333	125
bis(2-ethylhexyl)phthala	5	16	31.3	340	-	1,000	36	220	280	146
Chrysene	4	16	25	340	-	1,000	44	190	273	150
Di-n-butylphthalate	1	16	6.25	350	-	1,000	34	34	330	133
Fluoranthene	6	16	37.5	340	-	870	79	340	248	133
Indeno(1,2,3-cd)pyrene	2	16	12.5	340	-	1,000	57	86	309	142
Methylene Chloride	10	16	62.5	7	-	57	2.60	3.30	5.57	6.52
Naphthalene	3	16	18.8	5.80	-	500	1.70	2.50	76.4	99.8
Phenanthrene	6	16	37.5	340	-	870	57	280	237	138
Pyrene	2	16	12.5	340	-	1,000	210	320	333	113
Toluene	2	16	12.5	5	-	7.80	8	190	15.1	46.7
Total PAHs	7	16	43.8	2,720	-	5,883	2,952	5,474	4,208	1,177
Radionuclide (pCi/g)										
Americium-241	21	21	100	N/A			-0.0370	0.130	0.0269	0.0341
Cesium-134	5	5	100	N/A			1.28E-04	0.167	0.0810	0.0606
Cesium-137	9	9	100	N/A			0.0640	1.21	0.293	0.356
Gross Alpha	9	9	100	N/A			4.82	37	19.1	9.97
Gross Beta	9	9	100	N/A			6.45	32	22.4	8.82
Plutonium-239/240	23	23	100	N/A			-0.0140	0.447	0.0415	0.0924
Radium-226	5	5	100	N/A			0.910	1.53	1.22	0.234

Table 1.8
Summary of Sediment ECOI Data in the NN AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Radium-228	7	7	100	N/A	1.10	1.62	1.30	0.174
Strontium-89/90	9	9	100	N/A	0.0360	1.04	0.265	0.310
Uranium-233/234	21	21	100	N/A	0.480	1.51	0.974	0.229
Uranium-235	21	21	100	N/A	0	0.143	0.0621	0.0348
Uranium-238	21	21	100	N/A	0.500	1.58	0.982	0.228

[a] Values in this column represent reported results for U-qualified data (i.e., nondetects).

[b] For organics and inorganics, statistics are computed using one-half the reported result for nondetects.

[c] All radionuclide values are considered detects.

Table 1.9
Summary of Surface Water ECOI Data in the SE AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Inorganic (Dissolved) (mg/L)										
Copper	4	7	57.1	0.00200	-	0.00540	0.00210	0.00370	0.00238	9.25E-04
Lead	1	6	16.7	8.00E-04	-	0.00120	0.00230	0.00230	7.67E-04	7.55E-04
Manganese	5	7	71.4	0.00150	-	0.00150	0.00970	0.164	0.0346	0.0581
Nickel	1	7	14.3	0.00300	-	0.0112	0.0126	0.0126	0.00500	0.00372
Selenium	1	6	16.7	0.00100	-	0.00400	9.00E-04	9.00E-04	0.00113	6.57E-04
Silver	2	7	28.6	0.00200	-	0.00680	0.00260	0.00320	0.00231	8.76E-04
Zinc	2	7	28.6	0.00170	-	0.00720	0.00570	0.0108	0.00381	0.00351
Inorganic (Total) (mg/L)										
Aluminum	8	11	72.7	0.0550	-	0.0660	0.0379	0.274	0.0947	0.0935
Ammonia	1	1	100		N/A		0.280	0.280	0.280	0
Antimony	2	12	16.7	0.00320	-	0.0422	0.0265	0.0292	0.0115	0.00988
Barium	11	12	91.7	0.111	-	0.111	0.0314	0.120	0.0629	0.0285
Boron	3	4	75	0.0130	-	0.0130	0.0140	0.130	0.0491	0.0566
Calcium	12	12	100		N/A		25.4	110	50.3	24.9
Cesium	1	8	12.5	0.0250	-	0.617	0.0500	0.0500	0.175	0.122
Chloride	7	7	100	0	-	0	19	44	32.7	7.79
Fluoride	7	7	100		N/A		0.200	0.720	0.379	0.162
Iron	11	12	91.7	0.0280	-	0.0280	0.0490	0.546	0.217	0.173
Lithium	6	12	50	0.00200	-	0.00720	0.00200	0.0650	0.0101	0.0179
Magnesium	12	12	100		N/A		3.80	69	13.0	18.1
Molybdenum	3	12	25	0.00190	-	0.0130	0.00300	0.00460	0.00303	0.00172
Nitrate / Nitrite	3	8	37.5	0.100	-	0.100	0.0400	1.50	0.238	0.511
Phosphate	4	6	66.7	0.0200	-	0.0500	0.0200	0.0600	0.0358	0.0201
Phosphorus	1	7	14.3	0.0500	-	0.0500	0.0610	0.0610	0.0301	0.0136
Potassium	12	12	100		N/A		0.800	15	4.45	4.23
Silica	4	4	100		N/A		0.730	13	7.18	5.42
Silicon	8	8	100		N/A		2.41	6.06	3.14	1.24
Sodium	12	12	100		N/A		11	160	34.3	41.7
Strontium	12	12	100		N/A		0.0901	1.20	0.297	0.311
Sulfate	7	7	100		N/A		9.30	114	28.6	38.4
Sulfide	1	7	14.3	1	-	1	2	2	0.714	0.567

Table 1.9
Summary of Surface Water ECOI Data in the SE AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Tin	1	12	8.33	0.00470	-	0.0389	0.0130	0.0130	0.00619	0.00513
Titanium	1	4	25	0.00260	-	0.00260	0.00280	0.00280	0.00168	7.50E-04
Organic (Total) (ug/L)										
Methylene Chloride	1	7	14.3	2	-	10	10	10	4	2.97
Radionuclide (Total) (pCi/L)										
Americium-241	10	10	100	N/A			0.00300	0.0135	0.00673	0.00365
Cesium-137	6	6	100	N/A			-0.186	1.60	0.341	0.662
Gross Alpha	6	6	100	N/A			-0.100	1.30	0.517	0.550
Gross Beta	6	6	100	N/A			2.52	9.20	5.96	2.37
Plutonium-239/240	11	11	100	N/A			-0.00300	0.0604	0.00872	0.0189
Strontium-89/90	4	4	100	N/A			0.680	3.20	1.33	1.25
Tritium	5	5	100	N/A			-53.8	150	42.2	86.9
Uranium-233/234	8	8	100	N/A			0.0529	1.86	0.821	0.723
Uranium-235	8	8	100	N/A			0	0.117	0.0480	0.0420
Uranium-238	8	8	100	N/A			0	2.58	0.771	0.873

[a] Values in this column represent reported results for U-qualified data (i.e., nondetects).

[b] For organics and inorganics, statistics are computed using one-half the reported result for nondetects.

[c] All radionuclide values are considered detects.

Table 1.10
Summary of Sediment ECOI Data in the SE AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Inorganic (mg/kg)										
Aluminum	7	7	100		N/A		7,600	26,000	18,229	6,295
Arsenic	7	7	100		N/A		3.30	9.30	5.99	2.20
Barium	7	7	100		N/A		77	240	158	51.6
Beryllium	7	7	100		N/A		0.520	1.30	1.03	0.262
Boron	7	7	100		N/A		5.40	19	9.66	4.63
Cadmium	7	7	100		N/A		0.190	0.710	0.511	0.163
Calcium	7	7	100		N/A		4,900	55,000	15,700	17,954
Chromium	7	7	100		N/A		8.70	26	18.7	6.02
Cobalt	7	7	100		N/A		5.40	8.60	7.14	1.42
Copper	7	7	100		N/A		9.30	27	18.6	5.60
Iron	7	7	100		N/A		11,000	34,000	18,857	8,315
Lead	7	7	100		N/A		9.50	27	18.9	5.31
Lithium	7	7	100		N/A		6	23	14.4	5.97
Magnesium	7	7	100		N/A		1,700	7,100	3,700	1,850
Manganese	7	7	100		N/A		82	480	228	172
Mercury	7	7	100		N/A		0.0210	0.0800	0.0384	0.0214
Molybdenum	6	7	85.7	0.280	-	0.280	0.260	1	0.643	0.342
Nickel	7	7	100		N/A		9.60	21	16.4	3.89
Potassium	7	7	100		N/A		1,200	5,200	2,757	1,372
Selenium	1	7	14.3	0.850	-	2	1.70	1.70	0.729	0.471
Silica	7	7	100		N/A		980	2,900	1,854	604
Sodium	3	7	42.9	110	-	130	150	510	175	176
Strontium	7	7	100		N/A		38	290	87.4	91.0
Thallium	4	7	57.1	0.370	-	0.870	0.550	2.60	1.07	1.00
Titanium	7	7	100		N/A		64	260	168	77.1
Uranium	2	7	28.6	1.30	-	2.90	2.30	2.80	1.34	0.881
Vanadium	7	7	100		N/A		22	62	45.4	15.0
Zinc	7	7	100		N/A		36	81	65.6	15.3
Radionuclide (pCi/g)										
Americium-241	9	9	100		N/A		-0.0130	0.0997	0.0411	0.0367

Table 1.10
Summary of Sediment ECOI Data in the SE AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Plutonium-239/240	9	9	100	N/A	0.00205	0.216	0.109	0.0821
Uranium-233/234	9	9	100	N/A	0.958	3.18	1.69	0.650
Uranium-235	9	9	100	N/A	0.0351	0.188	0.110	0.0440
Uranium-238	9	9	100	N/A	0.860	3.39	1.53	0.754

[a] Values in this column represent reported results for U-qualified data (i.e., nondetects).

[b] For organics and inorganics, statistics are computed using one-half the reported result for nondetects.

[c] All radionuclide values are considered detects.

Table 2.1
RC AEU Surface Water ECOPC Summary

Analyte	MDC	Surface Water ESL	MDC > ESL?	Number of Samples	Number of Detects	Frequency of Detection	DF > 5%	Exceeds Background?[a]	95th UTL	95th UTL > ESL?	Professional Judgement	ECOPC?[b]
Inorganic (Dissolved) mg/L												
Arsenic	0.00440	0.150	No	41	3	7.32	--	--	--	--	--	No
Cadmium	0.00340	2.50E-04	Yes	42	6	14.3	Yes	N/A	0.00320	Yes	No	No
Chromium	0.0154	0.0740	No	41	3	7.32	--	--	--	--	--	No
Copper	0.0215	0.00900	Yes	42	21	50	Yes	No	--	--	--	No
Lead	0.0121	0.00250	Yes	41	12	29.3	Yes	N/A	0.00880	Yes	No	No
Manganese	0.486	1.65	No	42	39	92.9	--	--	--	--	--	No
Mercury	0.00477	7.70E-04	Yes	41	1	2.44	No	--	--	--	--	No
Nickel	0.00730	0.0520	No	42	3	7.14	--	--	--	--	--	No
Selenium	0.00380	0.00460	No	42	3	7.14	Yes	N/A	0.00380	N/A	--	No
Silver	0.00200	3.20E-04	Yes	42	1	2.38	No	N/A	--	--	--	No
Thallium	4.30E-04	0.0150	No	40	1	2.50	--	--	--	--	--	No
Zinc	0.0235	0.118	No	42	23	54.8	--	--	--	--	--	No
Inorganic (Total) (mg/L)												
Aluminum	129	0.0870	Yes	109	98	89.9	Yes	No	19.5	Yes	--	No
Antimony	0.00630	0.240	No	110	13	11.8	--	--	--	--	--	No
Barium	0.630	0.438	Yes	109	108	99.1	Yes	Yes	0.137	No	--	No
Beryllium	0.00370	0.00240	Yes	109	27	24.8	Yes	N/A	8.50E-04	No	--	No
Calcium	152	N/A	N/A	109	109	100	Yes	--	--	--	--	N/A
Cesium	0.0600	N/A	N/A	44	4	9.09	Yes	N/A	0.0600	N/A	--	N/A
Chloride	76	230,000	No	98	92	93.9	--	--	--	--	--	No
Cobalt	0.0193	0.100	No	109	34	31.2	--	--	--	--	--	No
Cyanide	0.0260	5.00E-04	Yes	34	2	5.88	Yes	N/A[C]	--	--	--	No
Fluoride	1	2.12	No	98	94	95.9	--	--	--	--	--	No
Iron	88.6	1	Yes	109	107	98.2	Yes	No	11.2	Yes	--	No
Lithium	0.154	0.0960	Yes	102	79	77.5	Yes	Yes	0.0273	No	--	No
Magnesium	18.2	N/A	N/A	109	108	99.1	Yes	--	--	--	--	N/A
Molybdenum	0.00840	0.800	No	102	41	40.2	--	--	--	--	--	No
Nitrate / Nitrite	2.07	N/A	N/A	40	26	65	Yes	--	--	--	--	N/A
Nitrite	0.0580	4.47	No	32	1	3.13	--	--	--	--	--	No
Ortho-phosphate	0.110	N/A	N/A	20	1	5	--	--	--	--	--	N/A
Phosphate	0.0600	N/A	N/A	16	11	68.8	Yes	--	--	--	--	N/A
Phosphorus	0.180	N/A	N/A	27	9	33.3	Yes	--	--	--	--	N/A
Potassium	15.4	N/A	N/A	109	102	93.6	Yes	--	--	--	--	N/A

Table 2.1
RC AEU Surface Water ECOPC Summary

Analyte	MDC	Surface Water ESL	MDC > ESL?	Number of Samples	Number of Detects	Frequency of Detection	DF > 5%	Exceeds Background?[a]	95th UTL	95th UTL > ESL?	Professional Judgement	ECOPC?[b]
Silica	21	N/A	N/A	3	3	100	Yes	--	--	--	--	N/A
Silicon	177	N/A	N/A	46	46	100	Yes	--	--	--	--	N/A
Sodium	35	N/A	N/A	109	109	100	Yes	--	--	--	--	N/A
Strontium	0.703	8.30	No	102	101	99.0	--	--	--	--	--	No
Sulfate	258	N/A	N/A	98	97	99.0	Yes	--	--	--	--	N/A
Sulfide	16	N/A	N/A	33	2	6.06	Yes	--	--	--	--	N/A
Tin	0.0190	0.0730	No	99	10	10.1	--	--	--	--	--	No
Titanium	0.0110	N/A	N/A	3	1	33.3	Yes	--	--	--	--	N/A
Vanadium	0.132	0.0120	Yes	109	66	60.6	Yes	No	0.0393	Yes	--	No
Organic (Total) (ug/L)												
Acetone	28	1,500	No	29	2	6.90	--	--	--	--	--	No
Chlorobenzene	0.400	47	No	43	1	2.33	--	--	--	--	--	No
Chlorodifluorometham	3	N/A	N/A	3	3	100	Yes	--	--	--	--	N/A
Chloroform	0.200	1,240	No	43	2	4.65	--	--	--	--	--	No
Methylene Chloride	2	940	No	43	3	6.98	--	--	--	--	--	No
Tetrachloroethene	10	840	No	43	1	2.33	--	--	--	--	--	No
Radionuclide (Total) (pCi/L)												
Americium-241	0.127	43.8	No	37	37	100	--	--	--	--	--	No
Cesium-137	0.890	42.6	No	23	23	100	--	--	--	--	--	No
Curium-244	0.00200	N/A	N/A	1	1	100	Yes	--	--	--	--	N/A
Gross Alpha	45	N/A	N/A	24	24	100	Yes	--	--	--	--	N/A
Gross Beta	35	N/A	N/A	24	24	100	Yes	--	--	--	--	N/A
Neptunium-237	0.00900	N/A	N/A	2	2	100	Yes	--	--	--	--	N/A
Plutonium-239/240	1.69	18.7	No	35	35	100	--	--	--	--	--	No
Radium-226	4.90	1.02	Yes	3	3	100	Yes	N/A[C]	--	--	--	No
Strontium-89/90	1.80	278	No	17	17	100	--	--	--	--	--	No
Thorium-230	0.220	N/A	N/A	1	1	100	Yes	--	--	--	--	N/A
Thorium-232	-0.0290	N/A	N/A	1	1	100	Yes	--	--	--	--	N/A
Tritium	320	N/A	N/A	27	27	100	Yes	--	--	--	--	N/A
Uranium-233/234	5.10	20.1	No	29	29	100	--	--	--	--	--	No

Table 2.1
RC AEU Surface Water ECOPC Summary

Analyte	MDC	Surface Water ESL	MDC > ESL?	Number of Samples	Number of Detects	Frequency of Detection	DF > 5%	Exceeds Background?[a]	95th UTL	95th UTL > ESL?	Professional Judgement	ECOPC?[b]
Uranium-235	0.290	21.7	No	29	29	100	--	--	--	--	--	No
Uranium-238	4.90	22.3	No	29	29	100	--	--	--	--	--	No

[a] Decision based on statistical background comparisons. Statistical comparisons were not performed if analyte was detected at a frequency less than 20% in site or background data set.

[b] Analyte is eliminated as an ECOPC if: MDC < ESL, DF< 5%, less than background, or 95th UTL < ESL.

[c] Analyte was only detected in sample locations defined as background locations. The ECOI was removed from further consideration as and ECOPC

Table 2.2
Summary of Screening Steps for Sediment ECOPCs in the RC AEU

Analyte	MDC	Sediment ESL	EPC > ESL?	Number of Samples	Number of Detects	Frequency of Detection	DF > 5%	Exceeds Background?[a]	95th UTL	95th UTL > ESL?	Professional Judgement	ECOPC?[b]
Inorganics (mg/kg)												
Aluminum	19,500	15,900	Yes	22	22	100	Yes	Yes	19,500	Yes	No	No
Antimony	11.1	2	Yes	19	1	5.26	Yes	N/A[d]	--	--	--	No
Arsenic	15	9.79	Yes	22	21	95.5	Yes	Yes	15	Yes	No	No
Barium	360	189	Yes	22	22	100	Yes	Yes	303	Yes	No	No
Beryllium	2.10	N/A	N/A	19	14	73.7	Yes	--	--	--	--	N/A
Boron	17	N/A	N/A	5	5	100	Yes	--	--	--	--	N/A
Cadmium	1.30	0.990	Yes	19	7	36.8	Yes	N/A	1.30	Yes	No	No
Calcium	61,000	N/A	N/A	22	22	100	Yes	--	--	--	--	N/A
Cesium	2.90	N/A	N/A	15	1	6.67	Yes	--	--	--	--	N/A
Chromium	28.2	43.4	No	22	21	95.5	--	--	--	--	--	No
Cobalt	18	N/A	N/A	21	20	95.2	Yes	--	--	--	--	N/A
Copper	29.9	31.6	No	22	20	90.9	--	--	--	--	--	No
Iron	39,000	20,000	Yes	22	22	100	Yes	Yes	39,000	Yes	No	No
Lead	79.1	35.8	Yes	22	22	100	Yes	Yes	79.1	Yes	No	No
Lithium	20.3	N/A	N/A	21	21	100	Yes	--	--	--	--	N/A
Magnesium	4,100	N/A	N/A	22	22	100	Yes	--	--	--	--	N/A
Manganese	2,500	630	Yes	22	22	100	Yes	No	--	--	--	No
Mercury	0.0660	0.180	No	19	5	26.3	--	--	--	--	--	No
Molybdenum	9.60	N/A	N/A	20	4	20	Yes	--	--	--	--	N/A
Nickel	23	22.7	Yes	21	20	95.2	Yes	Yes	19.3	No	--	No
Nitrate / Nitrite	76	N/A	N/A	15	10	66.7	Yes	--	--	--	--	N/A
Potassium	2,900	N/A	N/A	21	21	100	Yes	--	--	--	--	N/A
Selenium	3.20	0.950	Yes	22	7	31.8	Yes	Yes	3.20	Yes	No	No
Silica	2,600	N/A	N/A	5	5	100	Yes	--	--	--	--	N/A
Silicon	1,480	N/A	N/A	11	11	100	Yes	--	--	--	--	N/A
Silver	3.40	1	Yes	19	4	21.1	Yes	N/A	3.40	Yes	No	No
Sodium	413	N/A	N/A	22	16	72.7	Yes	--	--	--	--	N/A
Strontium	179	N/A	N/A	22	22	100	Yes	--	--	--	--	N/A
Thallium	0.410	N/A	N/A	19	2	10.5	Yes	--	--	--	--	N/A
Tin	37.1	N/A	N/A	19	6	31.6	Yes	--	--	--	--	N/A
Titanium	170	N/A	N/A	5	5	100	Yes	--	--	--	--	N/A
Uranium	7.80	N/A	N/A	5	2	40	Yes	--	--	--	--	N/A
Vanadium	57.1	N/A	N/A	22	22	100	Yes	--	--	--	--	N/A
Zinc	720	121	Yes	22	21	95.5	Yes	Yes	720	Yes	No	No
Organics (ug/kg)												
1,1,1-Trichloroethane	9	159	No	11	1	9.09	--	--	--	--	--	No
2-Butanone	190	84.2	Yes	13	2	15.4	Yes	N/A[d]	--	--	--	No
4,6-Dinitro-2-methylphenol	1,100	N/A	N/A	17	1	5.88	Yes	--	--	--	--	N/A
4-Methylphenol	1,500	12.3	Yes	20	3	15.0	Yes	N/A[d]	--	--	--	No

Table 2.2
Summary of Screening Steps for Sediment ECOPCs in the RC AEU

Analyte	MDC	Sediment ESL	EPC > ESL?	Number of Samples	Number of Detects	Frequency of Detection	DF > 5%	Exceeds Background?[a]	95th UTL	95th UTL > ESL?	Professional Judgement	ECOPC?[b]
4-Nitrophenol	1,300	N/A	N/A	17	1	5.88	Yes	--	--	--	--	N/A
Acetone	520	N/A	N/A	11	4	36.4	Yes	--	--	--	--	N/A
Benzo(a)anthracene	62	108	No	19	1	5.26	--	--	--	--	--	No
Benzo(a)pyrene	130	150	No	18	1	5.56	--	--	--	--	--	No
Benzoic Acid	2,000	N/A	N/A	20	7	35	Yes	--	--	--	--	N/A
bis(2-ethylhexyl)phthalate	350	24,900	No	18	7	38.9	--	--	--	--	--	No
Chrysene	74	166	No	19	1	5.26	--	--	--	--	--	No
Di-n-butylphthalate	250	612	No	20	6	30.0	--	--	--	--	--	No
Fluoranthene	89	423	No	19	1	5.26	--	--	--	--	--	No
Methylene Chloride	300	N/A	N/A	15	1	6.67	Yes	--	--	--	--	N/A
Pentachlorophenol	1,500	255	Yes	19	1	5.26	Yes	N/A	1,500	Yes	--	No
Phenanthrene	59	204	No	19	1	5.26	--	--	--	--	--	No
Phenol	120	773	No	19	1	5.26	--	--	--	--	--	No
Pyrene	130	195	No	19	1	5.26	--	--	--	--	--	No
Tetrachloroethene	38	3,050	No	10	1	10	--	--	--	--	--	No
Toluene	39	1,660	No	10	1	10	--	--	--	--	--	No
Total PAHs	3,730	1,610	Yes	19	2	10.5	Yes[C]	N/A	3,730	Yes	No	No
Trichloroethene	48	22,800	No	11	1	9.09	--	--	--	--	--	No
Xylene	14	91	No	10	1	10	--	--	--	--	--	No
Radionuclides (pCi/g)												
Americium-241	0.0376	5,150	No	18	18	100	--	--	--	--	--	No
Cesium-134	0.260	N/A	N/A	6	6	100	Yes	--	--	--	--	N/A
Cesium-137	1.50	3,120	No	15	15	100	--	--	--	--	--	No
Gross Alpha	62	N/A	N/A	15	15	100	Yes	--	--	--	--	N/A
Gross Beta	54	N/A	N/A	15	15	100	Yes	--	--	--	--	N/A
Plutonium-239/240	0.0810	5,860	No	20	20	100	--	--	--	--	--	No
Radium-226	1.80	101	No	9	9	100	--	--	--	--	--	No
Radium-228	4.10	87.8	No	9	9	100	--	--	--	--	--	No
Strontium-89/90	0.560	582	No	14	14	100	--	--	--	--	--	No
Uranium-233/234	2.30	5,280	No	18	18	100	--	--	--	--	--	No
Uranium-235	0.269	3,730	No	18	18	100	--	--	--	--	--	No
Uranium-238	2.30	2,490	No	18	18	100	--	--	--	--	--	No

[a] Decision based on statistical background comparisons. Statistical comparisons were not performed if analyte was detected at a frequency less than 20% in site or background data set.

[b] Analyte is eliminated as an ECOPC if: MDC < ESL, DF< 5%, less than background, or 95th UTL < ESL.

[c] The MDC for total PAHs was skewed high by elevated proxy values for non-detected PAHs. Only benz(a)pyrene was detected. It was detected at a concentration less than the ESL. See Section 2.3.1.

[d] Analyte was only detected in sample locations defined as background locations. The ECOI was removed from further consideration as and ECOPC

Table 2.3
MK AEU Surface Water ECOPC Summary

Analyte	MDC	Surface Water ESL	MDC > ESL?	Number of Samples	Number of Detects	Frequency of Detection	DF > 5%	Exceeds Background?[a]	95th UTL	95th UTL > ESL?	Professional Judgement	ECOPC?[b]
Inorganic (Dissolved) (mg/L)												
Arsenic	0.00250	0.150	No	24	3	12.5	--	--	--	--	--	No
Cadmium	0.00300	2.50E-04	Yes	26	5	19.2	Yes	N/A	0.00300	Yes	Yes	Yes
Chromium	0.0244	0.0740	No	26	10	38.5	--	--	--	--	--	No
Copper	0.0250	0.00900	Yes	24	17	70.8	Yes	No	--	--	--	No
Lead	0.0708	0.00250	Yes	25	14	56	Yes	No	--	--	--	No
Manganese	0.316	1.65	No	27	27	100	--	--	--	--	--	No
Nickel	0.0131	0.0520	No	26	10	38.5	--	--	--	--	--	No
Selenium	0.00390	0.00460	No	26	4	15.4	--	--	--	--	--	No
Silver	0.00230	3.20E-04	Yes	26	1	3.85	No	--	--	--	--	No
Thallium	0.00650	0.0150	No	26	2	7.69	--	--	--	--	--	No
Zinc	0.245	0.118	Yes	26	22	84.6	Yes	Yes	0.245	Yes	Yes	Yes
Inorganic (Total) (mg/L)												
Aluminum	46	0.0870	Yes	39	39	100	Yes	Yes	17.7	Yes	Yes	Yes
Antimony	0.00510	0.240	No	39	1	2.56	--	--	--	--	--	No
Barium	0.340	0.438	No	39	35	89.7	--	--	--	--	--	No
Boron	0.0200	1.90	No	2	2	100	--	--	--	--	--	No
Calcium	110	N/A	N/A	39	39	100	--	--	--	--	--	N/A
Cerium	0.0295	N/A	N/A	4	4	100	--	--	--	--	--	N/A
Cesium	0.0500	N/A	N/A	26	6	23.1	--	--	--	--	--	N/A
Chloride	67	230,000	No	24	24	100	--	--	--	--	--	No
Cobalt	0.0100	0.100	No	39	14	35.9	--	--	--	--	--	No
Fluoride	0.360	2.12	No	22	20	90.9	--	--	--	--	--	No
Iron	42	1	Yes	38	38	100	Yes	Yes	13.9	Yes	Yes	Yes
Lithium	0.0210	0.0960	No	30	13	43.3	--	--	--	--	--	No
Magnesium	23	N/A	N/A	39	39	100	--	--	--	--	--	N/A
Molybdenum	6.00E-04	0.800	No	34	1	2.94	--	--	--	--	--	No
Nitrate / Nitrite	2.20	N/A	N/A	27	23	85.2	--	--	--	--	--	N/A
Nitrite	0.0370	4.47	No	10	1	10	--	--	--	--	--	No
Ortho-phosphate	0.580	N/A	N/A	6	1	16.7	--	--	--	--	--	N/A
Phosphate	0.0600	N/A	N/A	5	5	100	--	--	--	--	--	N/A
Phosphorus	0.180	N/A	N/A	14	10	71.4	--	--	--	--	--	N/A
Potassium	18	N/A	N/A	39	39	100	--	--	--	--	--	N/A

Table 2.3
MK AEU Surface Water ECOPC Summary

Analyte	MDC	Surface Water ESL	MDC > ESL?	Number of Samples	Number of Detects	Frequency of Detection	DF > 5%	Exceeds Background?[a]	95th UTL	95th UTL > ESL?	Professional Judgement	ECOPC?[b]
Silica	17	N/A	N/A	3	3	100	--	--	--	--	--	N/A
Silicon	60	N/A	N/A	31	31	100	--	--	--	--	--	N/A
Sodium	490	N/A	N/A	39	39	100	--	--	--	--	--	N/A
Strontium	0.590	8.30	No	32	31	96.9	--	--	--	--	--	No
Sulfate	34.5	N/A	N/A	24	21	87.5	--	--	--	--	--	N/A
Tin	0.0280	0.0730	No	34	1	2.94	--	--	--	--	--	No
Titanium	0.0350	N/A	N/A	2	2	100	--	--	--	--	--	N/A
Vanadium	0.0820	0.0120	Yes	39	20	51.3	Yes	No	--	--	--	No
Organic (Total) (ug/L)												
2-Butanone	3	2,200	No	12	1	8.33	--	--	--	--	--	No
bis(2-ethylhexyl)phtha	1	28.5	No	2	1	50	--	--	--	--	--	No
Methylene Chloride	16	940	No	13	1	7.69	--	--	--	--	--	No
Tetrachloroethene	5	840	No	13	1	7.69	--	--	--	--	--	No
Trichloroethene	5	21,900	No	13	1	7.69	--	--	--	--	--	No
Radionuclides (Total) (pCi/L)												
Cesium-137	0.740	42.6	No	7	7	100	--	--	--	--	--	No
Gross Alpha	33	N/A	N/A	27	27	100	--	--	--	--	--	N/A
Gross Beta	60	N/A	N/A	29	29	100	--	--	--	--	--	N/A
Plutonium-238	0.0134	N/A	N/A	8	8	100	--	--	--	--	--	N/A
Plutonium-239/240	0.500	18.7	No	35	35	100	--	--	--	--	--	No
Radium-226	0.540	1.02	No	1	1	100	--	--	--	--	--	No
Strontium-89/90	2.10	278	No	6	6	100	--	--	--	--	--	No
Tritium	751	N/A	N/A	8	8	100	--	--	--	--	--	N/A
Uranium-233/234	5.93	20.1	No	34	34	100	--	--	--	--	--	No
Uranium-235	0.190	21.7	No	34	34	100	--	--	--	--	--	No
Uranium-238	3.39	22.3	No	34	34	100	--	--	--	--	--	No

[a] Decision based on statistical background comparisons. Statistical comparisons were not performed if analyte was detected at a frequency less than 20% in site or background data se

[b] Analyte is eliminated as an ECOPC if: MDC < ESL, DF< 5%, less than background, or 95th UTL < ESL.

Table 2.4
Summary Screening Steps for Sediment ECOPCs in the MK AEU

Analyte	MDC	Sediment ESL	Number of Samples	Number of Detects	EPC > ESL?	Frequency of Detection	DF > 5%	Exceeds Background?[a]	95th UTL	95th UTL > ESL?	Professional Judgement	ECOPC?[b]
Inorganics (mg/kg)												
Aluminum	30,300	15,900	12	12	Yes	100	Yes	Yes	30,003	Yes	Yes	Yes
Antimony	12.4	2	12	1	Yes	8.33	Yes	No [c]	--	--	--	No
Arsenic	8.40	9.79	12	12	No	100	Yes	--	--	--	--	No
Barium	170	189	12	12	No	100	Yes	--	--	--	--	No
Beryllium	1.50	N/A	12	10	N/A	83.3	Yes	--	--	--	--	N/A
Boron	6.40	N/A	4	4	N/A	100	Yes	--	--	--	--	N/A
Cadmium	0.490	0.990	12	5	No	41.7	Yes	--	--	--	--	No
Calcium	130,000	N/A	12	12	N/A	100	Yes	--	--	--	--	N/A
Cesium	4.90	N/A	8	1	N/A	12.5	Yes	--	--	--	--	N/A
Chromium	44.3	43.4	12	12	Yes	100	Yes	Yes	44.3	Yes	Yes	Yes
Chromium VI	0.0130	43.4	1	1	No	100	Yes	--	--	--	--	No
Cobalt	9.30	N/A	12	11	N/A	91.7	Yes	--	--	--	--	N/A
Copper	33.2	31.6	12	11	Yes	91.7	Yes	No	--	--	--	No
Fluoride	8.47	0.0100	1	1	Yes	100	Yes	N/A	8.47	N/A	Yes	Yes
Iron	27,500	20,000	12	12	Yes	100	Yes	No	--	--	--	No
Lead	73.6	35.8	12	12	Yes	100	Yes	No	--	--	--	No
Lithium	19.2	N/A	12	12	N/A	100	Yes	--	--	--	--	N/A
Magnesium	4,700	N/A	12	12	N/A	100	Yes	--	--	--	--	N/A
Manganese	326	630	12	12	No	100	Yes	--	--	--	--	No
Mercury	0.160	0.180	12	4	No	33.3	Yes	--	--	--	--	No
Molybdenum	2.40	N/A	12	7	N/A	58.3	Yes	--	--	--	--	N/A
Nickel	28.3	22.7	12	11	Yes	91.7	Yes	Yes	28.3	Yes	Yes	Yes
Nitrate / Nitrite	64	N/A	7	4	N/A	57.1	Yes	--	--	--	--	N/A
Potassium	2,940	N/A	12	12	N/A	100	Yes	--	--	--	--	N/A
Selenium	2.70	0.950	12	1	Yes	8.33	Yes	N/A	2.70	Yes	Yes	Yes
Silica	970	N/A	4	4	N/A	100	Yes	--	--	--	--	N/A
Silicon	854	N/A	3	3	N/A	100	Yes	--	--	--	--	N/A
Sodium	2,090	N/A	12	12	N/A	100	Yes	--	--	--	--	N/A
Strontium	180	N/A	12	12	N/A	100	Yes	--	--	--	--	N/A
Thallium	0.400	N/A	12	1	N/A	8.33	Yes	--	--	--	--	N/A
Tin	9.30	N/A	12	3	N/A	25	Yes	--	--	--	--	N/A
Titanium	150	N/A	4	4	N/A	100	Yes	--	--	--	--	N/A

Table 2.4
Summary Screening Steps for Sediment ECOPCs in the MK AEU

Analyte	MDC	Sediment ESL	Number of Samples	Number of Detects	EPC > ESL?	Frequency of Detection	DF > 5%	Exceeds Background?[a]	95th UTL	95th UTL > ESL?	Professional Judgement	ECOPC?[b]
Uranium	1.10	N/A	4	1	N/A	25	Yes	--	--	--	--	N/A
Vanadium	67.7	N/A	12	12	N/A	100	Yes	--	--	--	--	N/A
Zinc	347	121	12	12	Yes	100	Yes	No	--	--	--	No
Organics (ug/kg)												
2-Butanone	3	84.2	8	1	No	12.5	Yes	--	--	--	--	No
4-Methylphenol	95	12.3	8	1	Yes	12.5	Yes	No [c]	--	--	--	No
Benzoic Acid	480	N/A	7	1	N/A	14.3	Yes	--	--	--	--	N/A
bis(2-ethylhexyl)phthalate	120	24,900	8	3	No	37.5	Yes	--	--	--	--	No
Chrysene	150	166	8	1	No	12.5	Yes	--	--	--	--	No
Di-n-butylphthalate	280	612	8	3	No	37.5	Yes	--	--	--	--	No
Fluoranthene	170	423	8	2	No	25	Yes	--	--	--	--	No
Phenanthrene	96	204	8	1	No	12.5	Yes	--	--	--	--	No
Pyrene	170	195	8	2	No	25	Yes	--	--	--	--	No
Toluene	6	1,660	8	2	No	25	Yes	--	--	--	--	No
Total PAHs	5926	1,610	8	2	Yes	25	Yes	N/A	2,964	Yes	Yes	Yes
Radionuclides (pCi/g)												
Americium-241	0.0869	5,150	12	12	No	100	Yes	--	--	--	--	No
Cesium-134	0.200	N/A	3	3	N/A	100	Yes	--	--	--	--	N/A
Cesium-137	0.391	3,120	7	7	No	100	Yes	--	--	--	--	No
Gross Alpha	79	N/A	9	9	N/A	100	Yes	--	--	--	--	N/A
Gross Beta	69	N/A	9	9	N/A	100	Yes	--	--	--	--	N/A
Plutonium-239/240	0.0538	5,860	12	12	No	100	Yes	--	--	--	--	No
Radium-226	1.90	101	5	5	No	100	Yes	--	--	--	--	No
Radium-228	1.70	87.8	3	3	No	100	Yes	--	--	--	--	No
Strontium-89/90	0.316	582	7	7	No	100	Yes	--	--	--	--	No
Uranium-233/234	15	5,280	12	12	No	100	Yes	--	--	--	--	No
Uranium-235	0.460	3,730	12	12	No	100	Yes	--	--	--	--	No
Uranium-238	13	2490	12	12	No	100	Yes	--	--	--	--	No

[a] Decision based on statistical background comparisons. Statistical comparisons were not performed if analyte was detected at a frequency less than 20% in site or background data set.

[b] Analyte is eliminated as an ECOPC if: MDC < ESL, DF< 5%, less than background, or 95th UTL < ESL.

[c] Analyte was only detected in sample locations defined as background locations. The ECOI was removed from further consideration as and ECOPC

Table 2.5
NN AEU Surface Water ECOPC Summary

Analyte	MDC	Surface Water ESL	MDC > ESL?	Number of Samples	Number of Detects	Frequency of Detection	DF > 5%	Exceeds Background?[a]	95th UTL	95th UTL > ESL?	Professional Judgement	ECOPC?[b]
Inorganic (Dissolved) (mg/L)												
Arsenic	0.00240	0.150	No	30	11	36.7	--	--	--	--	--	No
Cadmium	0.00330	2.50E-04	Yes	32	1	3.13	No	--	--	--	--	No
Chromium	0.00420	0.0740	No	31	2	6.45	--	--	--	--	--	No
Copper	0.0120	0.00900	Yes	31	13	41.9	Yes	No	--	--	--	No
Lead	0.00470	0.00250	Yes	32	5	15.6	Yes	N/A	0.00260	Yes	Yes	Yes
Manganese	1.50	1.65	No	29	24	82.8	--	--	--	--	--	No
Nickel	0.0246	0.0520	No	31	8	25.8	--	--	--	--	--	No
Selenium	0.0425	0.00460	Yes	32	3	9.38	Yes	N/A	0.0125	Yes	Yes	Yes
Silver	0.0131	3.20E-04	Yes	32	5	15.6	Yes	N/A	0.00610	Yes	Yes	Yes
Zinc	1.50	0.118	Yes	31	23	74.2	Yes	Yes	1.50	Yes	Yes	Yes
Inorganic (Total) (mg/L)												
Aluminum	55.4	0.0870	Yes	56	48	85.7	Yes	No	--	--	--	No
Ammonia-Unionized	0.0216	0.0200	Yes	3	1	33.3	Yes	N/A	0.0216	N/A	Yes	Yes
Antimony	0.0150	0.240	No	58	9	15.5	--	--	--	--	--	No
Barium	0.820	0.438	Yes	58	58	100	Yes	Yes	0.643	Yes	Yes	Yes
Beryllium	0.00250	0.00240	Yes	57	14	24.6	Yes	N/A	0.00140	No	--	No
Calcium	166	N/A	N/A	57	57	100	Yes	--	--	--	--	N/A
Chloride	286	230,000	No	29	28	96.6	--	--	--	--	--	No
Cobalt	0.0123	0.100	No	58	21	36.2	--	--	--	--	--	No
Fluoride	0.950	2.12	No	28	27	96.4	--	--	--	--	--	No
Iron	117	1	Yes	57	57	100	Yes	No	96.1	Yes	Yes	No
Lithium	0.0976	0.0960	Yes	49	47	95.9	Yes	Yes	0.0840	No	--	No
Magnesium	54.6	N/A	N/A	57	57	100	Yes	--	--	--	--	N/A
Molybdenum	0.0213	0.800	No	53	23	43.4	--	--	--	--	--	No
Nitrate / Nitrite	1.90	N/A	N/A	36	13	36.1	Yes	--	--	--	--	N/A
Nitrite	0.0310	4.47	No	17	1	5.88	--	--	--	--	--	No
Phosphorus	0.150	N/A	N/A	16	7	43.8	Yes	--	--	--	--	N/A
Potassium	13.5	N/A	N/A	57	54	94.7	Yes	--	--	--	--	N/A
Silicon	18.3	N/A	N/A	26	26	100	Yes	--	--	--	--	N/A
Sodium	195	N/A	N/A	57	57	100	Yes	--	--	--	--	N/A
Strontium	1.23	8.30	No	53	53	100	--	--	--	--	--	No
Sulfate	143	N/A	N/A	31	26	83.9	Yes	--	--	--	--	N/A
Tin	0.0569	0.0730	No	49	4	8.16	--	--	--	--	--	No
Vanadium	0.0951	0.0120	Yes	58	28	48.3	Yes	No	0.0262	Yes	Yes	No
Organic (ug/L)												
1,1-Dichloroethane	10	740	No	53	9	17.0	--	--	--	--	--	No
1,2,4-Trichlorobenzene	3	50	No	35	1	2.86	--	--	--	--	--	No
1,2,4-Trimethylbenzene	2	17	No	22	1	4.55	--	--	--	--	--	No

Table 2.5
NN AEU Surface Water ECOPC Summary

Analyte	MDC	Surface Water ESL	MDC > ESL?	Number of Samples	Number of Detects	Frequency of Detection	DF > 5%	Exceeds Background?[a]	95th UTL	95th UTL > ESL?	Professional Judgement	ECOPC?[b]
1,2-Dichloroethene	4	1,100	No	31	2	6.45	--	--	--	--	--	No
1,2-Dichloropropane	0.960	5,700	No	53	2	3.77	--	--	--	--	--	No
2,4-Dimethylphenol	3	212	No	23	2	8.70	--	--	--	--	--	No
2-Methylnaphthalene	23	N/A	N/A	23	6	26.1	Yes	--	--	--	--	N/A
4-Bromophenyl-phenylether	3	N/A	N/A	22	1	4.55	No	--	--	--	--	N/A
4-Isopropyltoluene	3	N/A	N/A	22	1	4.55	No	--	--	--	--	N/A
4-Methylphenol	3	25	No	21	2	9.52	--	--	--	--	--	No
Acenaphthene	4	520	No	23	6	26.1	--	--	--	--	--	No
Acenaphthylene	2	N/A	N/A	22	1	4.55	No	--	--	--	--	N/A
Acetone	43	1,500	No	39	6	15.4	--	--	--	--	--	No
alpha-BHC	0.360	2.20	No	7	2	28.6	--	--	--	--	--	No
Benzene	2	530	No	53	3	5.66	--	--	--	--	--	No
beta-BHC	0	2.20	No	7	2	28.6	--	--	--	--	--	No
bis(2-ethylhexyl)phthalate	34	28.5	Yes	22	9	40.9	Yes	N/A	34	Yes	Yes	Yes
Bromoform	0.100	320	No	53	1	1.89	--	--	--	--	--	No
Butylbenzylphthalate	0.700	67	No	22	1	4.55	--	--	--	--	--	No
Chlorodifluoromethane	68	N/A	N/A	3	3	100	Yes	--	--	--	--	N/A
Chloroethane	62	N/A	N/A	53	9	17.0	Yes	--	--	--	--	N/A
Chloromethane	7	N/A	N/A	53	1	1.89	No	--	--	--	--	N/A
delta-BHC	0.180	2.20	No	7	2	28.6	--	--	--	--	--	No
Dibenzofuran	2	4	No	23	5	21.7	--	--	--	--	--	No
Dichlorofluoromethane	16	150	No	1	1	100	--	--	--	--	--	No
Diethylphthalate	3	110	No	23	5	21.7	--	--	--	--	--	No
Di-n-butylphthalate	48	9.70	Yes	22	4	18.2	Yes	N/A	48	Yes	Yes	Yes
Ethylbenzene	17	3,200	No	53	9	17.0	--	--	--	--	--	No
Fluorene	3	12	No	23	6	26.1	--	--	--	--	--	No
gamma-BHC (Lindane)	0	0.0800	No	7	2	28.6	--	--	--	--	--	No
Heptachlor	0	0.00380	No	7	2	28.6	--	--	--	--	--	No
Isophorone	0.200	1,300	No	22	1	4.55	--	--	--	--	--	No
Methylene Chloride	37	940	No	53	15	28.3	--	--	--	--	--	No
Naphthalene	25	620	No	36	9	25	--	--	--	--	--	No
Pentachlorophenol	4	6.73	No	23	1	4.35	--	--	--	--	--	No
Phenanthrene	6	2.40	Yes	23	6	26.1	Yes	N/A	6	Yes	Yes	Yes
Phenol	5,000	2,560	Yes	27	3	11.1	Yes	N/A	5,000	Yes	Yes	Yes
Pyrene	2	0.0250	Yes	22	1	4.55	No	--	--	--	--	No
Toluene	47	1,750	No	53	9	17.0	--	--	--	--	--	No
Total PAHs	2,146	620	No	36	10	27.80	Yes	N/A	38.00000	No	--	No
Trichloroethene	2	21,900	No	53	2	3.77	--	--	--	--	--	No
Vinyl Chloride	11	930	No	53	2	3.77	--	--	--	--	--	No

Table 2.5
NN AEU Surface Water ECOPC Summary

Analyte	MDC	Surface Water ESL	MDC > ESL?	Number of Samples	Number of Detects	Frequency of Detection	DF > 5%	Exceeds Background?[a]	95th UTL	95th UTL > ESL?	Professional Judgement	ECOPC?[b]
Xylene	24	35	No	47	9	19.1	--	--	--	--	--	No
Radionuclide (pCi/L)												
Americium-241	0.0330	43.8	No	65	65	100	--	--	--	--	--	No
Cesium-137	1.20	42.6	No	20	20	100	--	--	--	--	--	No
Gross Alpha	8.20	N/A	N/A	25	25	100	Yes	--	--	--	--	N/A
Gross Beta	20	N/A	N/A	26	26	100	Yes	--	--	--	--	N/A
Plutonium-238	0.0188	N/A	N/A	5	5	100	Yes	--	--	--	--	N/A
Plutonium-239/240	0.0560	18.7	No	64	64	100	--	--	--	--	--	No
Radium-226	0.230	1.02	No	2	2	100	--	--	--	--	--	No
Strontium-89/90	4.06	278	No	15	15	100	--	--	--	--	--	No
Tritium	1,500	N/A	N/A	30	30	100	Yes	--	--	--	--	N/A
Uranium-233/234	4.07	20.1	No	49	49	100	--	--	--	--	--	No
Uranium-235	0.338	21.7	No	49	49	100	--	--	--	--	--	No
Uranium-238	3.65	22.3	No	49	49	100	--	--	--	--	--	No

[a] Decision based on statistical background comparisons. Statistical comparisons were not performed if analyte was detected at a frequency less than 20% in site or background data set.
[b] Analyte is eliminated as an ECOPC if: MDC < ESL, DF< 5%, less than background, or 95th UTL < ESL.
NOTE: Several pesticides are shown with MDCs equal to 0. These data were flagged as detections with qualifiers indicating matrix interference.

Table 2.6
Summary of Screening Steps for Sediment ECOPCs in the NN AEU

Analyte	MDC	Sediment ESL	EPC > ESL?	Number of Samples	Number of Detects	Frequency of Detection	DF > 5%	Exceeds Background?[a]	95th UTL	95th UTL > ESL?	Professional Judgement	ECOPC?[b]
Inorganics (mg/kg)												
Aluminum	24,000	15,900	Yes	20	20	100	Yes	Yes	24,000	Yes	Yes	Yes
Arsenic	7.10	9.79	No	20	20	100	Yes	--	--	--	--	No
Barium	390	189	Yes	20	20	100	Yes	Yes	390	Yes	Yes	Yes
Beryllium	1.20	N/A	N/A	20	19	95	Yes	--	--	--	--	N/A
Boron	10	N/A	N/A	10	10	100	Yes	--	--	--	--	N/A
Cadmium	0.160	0.990	No	20	2	10	Yes	--	--	--	--	No
Calcium	74,000	N/A	N/A	20	20	100	Yes	--	--	--	--	N/A
Cesium	3.90	N/A	N/A	8	1	12.5	Yes	--	--	--	--	N/A
Chromium	25	43.4	No	20	19	95	Yes	--	--	--	--	No
Cobalt	11.8	N/A	N/A	20	20	100	Yes	--	--	--	--	N/A
Copper	19.1	31.6	No	20	20	100	Yes	--	--	--	--	No
Iron	21,500	20,000	Yes	20	20	100	Yes	Yes	21,500	Yes	Yes	Yes
Lead	37.6	35.8	Yes	20	20	100	Yes	Yes	37.6	Yes	Yes	Yes
Lithium	15	N/A	N/A	18	17	94.4	Yes	--	--	--	--	N/A
Magnesium	4,200	N/A	N/A	20	20	100	Yes	--	--	--	--	N/A
Manganese	1,100	630	Yes	20	20	100	Yes	No	--	--	--	No
Mercury	0.0900	0.180	No	20	11	55	Yes	--	--	--	--	No
Molybdenum	5.20	N/A	N/A	18	11	61.1	Yes	--	--	--	--	N/A
Nickel	17	22.7	No	20	20	100	Yes	--	--	--	--	No
Nitrate / Nitrite	3.20	N/A	N/A	10	7	70	Yes	--	--	--	--	N/A
Potassium	2,810	N/A	N/A	20	19	95	Yes	--	--	--	--	N/A
Selenium	0.880	0.950	No	19	6	31.6	Yes	--	--	--	--	No
Silica	2,000	N/A	N/A	10	10	100	Yes	--	--	--	--	N/A
Silicon	417	N/A	N/A	6	6	100	Yes	--	--	--	--	N/A
Silver	0.340	1	No	20	1	5	No	--	--	--	--	No
Sodium	600	N/A	N/A	20	17	85	Yes	--	--	--	--	N/A
Strontium	320	N/A	N/A	18	18	100	Yes	--	--	--	--	N/A
Thallium	2.30	N/A	N/A	20	9	45	Yes	--	--	--	--	N/A
Tin	16.6	N/A	N/A	18	5	27.8	Yes	--	--	--	--	N/A
Titanium	150	N/A	N/A	10	10	100	Yes	--	--	--	--	N/A
Vanadium	59	N/A	N/A	20	20	100	Yes	--	--	--	--	N/A
Zinc	110	121	No	20	20	100	Yes	--	--	--	--	No
Organics (ug/kg)												

Table 2.6
Summary of Screening Steps for Sediment ECOPCs in the NN AEU

Analyte	MDC	Sediment ESL	EPC > ESL?	Number of Samples	Number of Detects	Frequency of Detection	DF > 5%	Exceeds Background?[a]	95th UTL	95th UTL > ESL?	Professional Judgement	ECOPC?[b]
1,2,4-Trimethylbenzene	4.60	122	No	10	6	60.0	Yes	--	--	--	--	No
2-Butanone	13	84.2	No	16	1	6.25	Yes	--	--	--	--	No
Acetone	99	N/A	N/A	16	10	62.5	Yes	--	--	--	--	N/A
Anthracene	51	57.2	No	16	2	12.5	Yes	--	--	--	--	No
Benzo(a)anthracene	150	108	Yes	16	6	37.5	Yes	N/A	150	Yes	Yes	Yes
Benzo(a)pyrene	160	150	Yes	16	2	12.5	Yes	N/A	160	Yes	Yes	Yes
Benzo(b)fluoranthene	190	N/A	N/A	16	4	25	Yes	--	--	--	--	N/A
Benzo(g,h,i)perylene	89	13	Yes	16	2	12.5	Yes	N/A	89	Yes	Yes	Yes
Benzo(k)fluoranthene	110	240	No	16	1	6.25	Yes	--	--	--	--	No
bis(2-ethylhexyl)phthalate	220	24,900	No	16	5	31.3	Yes	--	--	--	--	No
Chrysene	190	166	Yes	16	4	25	Yes	N/A	190	Yes	Yes	Yes
Di-n-butylphthalate	34	612	No	16	1	6.25	Yes	--	--	--	--	No
Fluoranthene	340	423	No	16	6	37.5	Yes	--	--	--	--	No
Indeno(1,2,3-cd)pyrene	86	17	Yes	16	2	12.5	Yes	N/A	86	Yes	Yes	Yes
Methylene Chloride	3.30	N/A	N/A	16	10	62.5	Yes	--	--	--	--	N/A
Naphthalene	2.50	176	No	16	3	18.8	Yes	--	--	--	--	No
Phenanthrene	280	204	Yes	16	6	37.5	Yes	N/A	280	Yes	Yes	Yes
Pyrene	320	195	Yes	16	2	12.5	Yes	N/A	320	Yes	Yes	Yes
Toluene	190	1,660	No	16	2	12.5	Yes	--	--	--	--	No
Total PAHs	5,474	1,610	Yes	16	7	43.8	Yes	N/A	5,129	Yes	Yes	Yes
Radionuclides (pCi/g)												
Americium-241	0.130	5,150	No	21	21	100	Yes	--	--	--	--	No
Cesium-134	0.167	N/A	N/A	5	5	100	Yes	--	--	--	--	N/A
Cesium-137	1.21	3,120	No	9	9	100	Yes	--	--	--	--	No
Gross Alpha	37	N/A	N/A	9	9	100	Yes	--	--	--	--	N/A
Gross Beta	32	N/A	N/A	9	9	100	Yes	--	--	--	--	N/A
Plutonium-239/240	0.447	5,860	No	23	23	100	Yes	--	--	--	--	No
Radium-226	1.53	101	No	5	5	100	Yes	--	--	--	--	No
Radium-228	1.62	87.8	No	7	7	100	Yes	--	--	--	--	No
Strontium-89/90	1.04	582	No	9	9	100	Yes	--	--	--	--	No
Uranium-233/234	1.51	5,280	No	21	21	100	Yes	--	--	--	--	No

Table 2.6
Summary of Screening Steps for Sediment ECOPCs in the NN AEU

Analyte	MDC	Sediment ESL	EPC > ESL?	Number of Samples	Number of Detects	Frequency of Detection	DF > 5%	Exceeds Background?[a]	95th UTL	95th UTL > ESL?	Professional Judgement	ECOPC?[b]
Uranium-235	0.143	3,730	No	21	21	100	Yes	--	--	--	--	No
Uranium-238	1.58	2,490	No	21	21	100	Yes	--	--	--	--	No

[a] Decision based on statistical background comparisons. Statistical comparisons were not performed if analyte was detected at a frequency less than 20% in site or background data set.

[b] Analyte is eliminated as an ECOPC if: MDC < ESL, DF< 5%, less than background, or 95th UTL < ESL.

Table 2.7
SE AEU Surface Water ECOPC Summary

Analyte	MDC	Surface Water ESL	MDC > ESL?	Number of Samples	Number of Detects	Frequency of Detection	DF > 5%	Exceeds Background?[a]	95th UTL	95th UTL > ESL?	Professional Judgement	ECOPC?[b]
Inorganic (Dissolved) (mg/L)												
Copper	0.00370	0.00900	No	7	4	57.1	Yes	--	--	--	--	No
Lead	0.00230	0.00250	No	6	1	16.7	Yes	--	--	--	--	No
Manganese	0.164	1.65	No	7	5	71.4	Yes	--	--	--	--	No
Nickel	0.0126	0.0520	No	7	1	14.3	Yes	--	--	--	--	No
Selenium	9.00E-04	0.00460	No	6	1	16.7	Yes	--	--	--	--	No
Silver	0.00320	3.20E-04	Yes	7	2	28.6	Yes	N/A	0.00320	Yes	No	No
Zinc	0.0108	0.118	No	7	2	28.6	Yes	--	--	--	--	No
Inorganic (Total) (mg/L)												
Aluminum	0.274	0.0870	Yes	11	8	72.7	Yes	No	--	--	--	No
Ammonia (un-ionized)	0.005	0.0500	No	1	1	100.0	Yes	--	--	--	--	No
Antimony	0.0292	0.240	No	12	2	16.7	Yes	--	--	--	--	No
Barium	0.120	0.438	No	12	11	91.7	Yes	--	--	--	--	No
Boron	0.130	1.90	No	4	3	75	Yes	--	--	--	--	No
Calcium	110	N/A	N/A	12	12	100	Yes	--	--	--	--	N/A
Cesium	0.0500	N/A	N/A	8	1	12.5	Yes	--	--	--	--	N/A
Chloride	44	230,000	No	7	7	100	Yes	--	--	--	--	No
Fluoride	0.720	2.12	No	7	7	100	Yes	--	--	--	--	No
Iron	0.546	1	No	12	11	91.7	Yes	--	--	--	--	No
Lithium	0.0650	0.0960	No	12	6	50	Yes	--	--	--	--	No
Magnesium	69	N/A	N/A	12	12	100	Yes	--	--	--	--	N/A
Molybdenum	0.00460	0.800	No	12	3	25	Yes	--	--	--	--	No
Nitrate / Nitrite	1.50	N/A	N/A	8	3	37.5	Yes	--	--	--	--	N/A
Phosphate	0.0600	N/A	N/A	6	4	66.7	Yes	--	--	--	--	N/A
Phosphorus	0.0610	N/A	N/A	7	1	14.3	Yes	--	--	--	--	N/A
Potassium	15	N/A	N/A	12	12	100	Yes	--	--	--	--	N/A
Silica	13	N/A	N/A	4	4	100	Yes	--	--	--	--	N/A
Silicon	6.06	N/A	N/A	8	8	100	Yes	--	--	--	--	N/A
Sodium	160	N/A	N/A	12	12	100	Yes	--	--	--	--	N/A
Strontium	1.20	8.30	No	12	12	100	Yes	--	--	--	--	No
Sulfate	114	N/A	N/A	7	7	100	Yes	--	--	--	--	N/A
Sulfide	2	N/A	N/A	7	1	14.3	Yes	--	--	--	--	N/A
Tin	0.0130	0.0730	No	12	1	8.33	Yes	--	--	--	--	No
Titanium	0.00280	N/A	N/A	4	1	25	Yes	--	--	--	--	N/A
Organic (Total) (ug/L)												
Methylene Chloride	10	940	No	7	1	14.3	Yes	--	--	--	--	No

Table 2.7
SE AEU Surface Water ECOPC Summary

Analyte	MDC	Surface Water ESL	MDC > ESL?	Number of Samples	Number of Detects	Frequency of Detection	DF > 5%	Exceeds Background?[a]	95th UTL	95th UTL > ESL?	Professional Judgement	ECOPC?[b]
Radionuclides (Total) (pCi/L)												
Americium-241	0.0135	43.8	No	10	10	100	Yes	--	--	--	--	No
Cesium-137	1.60	42.6	No	6	6	100	Yes	--	--	--	--	No
Gross Alpha	1.30	N/A	N/A	6	6	100	Yes	--	--	--	--	N/A
Gross Beta	9.20	N/A	N/A	6	6	100	Yes	--	--	--	--	N/A
Plutonium-239/240	0.0604	18.7	No	11	11	100	Yes	--	--	--	--	No
Strontium-89/90	3.20	278	No	4	4	100	Yes	--	--	--	--	No
Tritium	150	N/A	N/A	5	5	100	Yes	--	--	--	--	N/A
Uranium-233/234	1.86	20.1	No	8	8	100	Yes	--	--	--	--	No
Uranium-235	0.117	21.7	No	8	8	100	Yes	--	--	--	--	No
Uranium-238	2.58	22.3	No	8	8	100	Yes	--	--	--	--	No

[a] Decision based on statistical background comparisons. Statistical comparisons were not performed if analyte was detected at a frequency less than 20% in site or background data set.

[b] Analyte is eliminated as an ECOPC if: MDC < ESL, DF< 5%, less than background, or 95th UTL < ESL.

Table 2.8
Summary of Screening Steps for Sediment ECOPCs in the SE AEU

Analyte	MDC	Sediment ESL	EPC > ESL?	Number of Samples	Number of Detects	Frequency of Detection	DF > 5%	Exceeds Background?[a]	95th UTL	95th UTL > ESL?	Professional Judgement	ECOPC?[b]
Inorganics (mg/kg)												
Aluminum	26,000	15,900	Yes	7	7	100	Yes	Yes	26,000	Yes	No	No
Arsenic	9.30	9.79	No	7	7	100	Yes	N/A	9.30	N/A		No
Barium	240	189	Yes	7	7	100	Yes	Yes	240	Yes	No	No
Beryllium	1.30	N/A	N/A	7	7	100	Yes	--	--	--	--	N/A
Boron	19	N/A	N/A	7	7	100	Yes	--	--	--	--	N/A
Cadmium	0.710	0.990	No	7	7	100	Yes	--	--	--	--	No
Calcium	55,000	N/A	N/A	7	7	100	Yes	--	--	--	--	N/A
Chromium	26	43.4	No	7	7	100	Yes	--	--	--	--	No
Cobalt	8.60	N/A	N/A	7	7	100	Yes	--	--	--	--	N/A
Copper	27	31.6	No	7	7	100	Yes	--	--	--	--	No
Iron	34,000	20,000	Yes	7	7	100	Yes	Yes	34,000	Yes	No	No
Lead	27	35.8	No	7	7	100	Yes	--	--	--	--	No
Lithium	23	N/A	N/A	7	7	100	Yes	--	--	--	--	N/A
Magnesium	7,100	N/A	N/A	7	7	100	Yes	--	--	--	--	N/A
Manganese	480	630	No	7	7	100	Yes	--	--	--	--	No
Mercury	0.0800	0.180	No	7	7	100	Yes	--	--	--	--	No
Molybdenum	1	N/A	N/A	7	6	85.7	Yes	--	--	--	--	N/A
Nickel	21	22.7	No	7	7	100	Yes	--	--	--	--	No
Potassium	5,200	N/A	N/A	7	7	100	Yes	--	--	--	--	N/A
Selenium	1.70	0.950	Yes	7	1	14.3	Yes	N/A	1.70	Yes	No	No
Silica	2,900	N/A	N/A	7	7	100	Yes	--	--	--	--	N/A
Sodium	510	N/A	N/A	7	3	42.9	Yes	--	--	--	--	N/A
Strontium	290	N/A	N/A	7	7	100	Yes	--	--	--	--	N/A
Thallium	2.60	N/A	N/A	7	4	57.1	Yes	--	--	--	--	N/A
Titanium	260	N/A	N/A	7	7	100	Yes	--	--	--	--	N/A
Uranium	2.80	N/A	N/A	7	2	28.6	Yes	--	--	--	--	N/A
Vanadium	62	N/A	N/A	7	7	100	Yes	--	--	--	--	N/A
Zinc	81	121	No	7	7	100	Yes	--	--	--	--	No
Radionuclide (pCi/g)												
Americium-241	0.0997	5,150	No	9	9	100	Yes	--	--	--	--	No
Plutonium-239/240	0.216	5,860	No	9	9	100	Yes	--	--	--	--	No
Uranium-233/234	3.18	5,280	No	9	9	100	Yes	--	--	--	--	No
Uranium-235	0.188	3,730	No	9	9	100	Yes	--	--	--	--	No
Uranium-238	3.39	2,490	No	9	9	100	Yes	--	--	--	--	No

Table 2.8
Summary of Screening Steps for Sediment ECOPCs in the SE AEU

Analyte	MDC	Sediment ESL	EPC > ESL?	Number of Samples	Number of Detects	Frequency of Detection	DF > 5%	Exceeds Background?[a]	95th UTL	95th UTL > ESL?	Professional Judgement	ECOPC?[b]

[a] Decision based on statistical background comparisons. Statistical comparisons were not performed if analyte was detected at a frequency less than 20% in site or background data set.

[b] Analyte is eliminated as an ECOPC if: MDC < ESL, DF< 5%, less than background, or 95th UTL < ESL.

Table 3.1
Surface Water Exposure Point Concentrations

ECOPC	Fraction	Surface Water UTL	Post-1999 Surface Water UTL
RC AEU			
No ECOPCs			
MK AEU			
Inorganics (mg/L)			
Aluminum	Total	17.7	1.70
Cadmium	Dissolved	0.003	N/A
Iron	Total	13.9	2.80
Zinc	Dissolved	0.245	N/A
NN AEU			
Inorganics (mg/L)			
Ammonia	Un-ionized	0.022	N/A*
Barium	Total	0.643	0.820
Lead	Dissolved	0.003	N/A*
Selenium	Dissolved	0.013	N/A*
Silver	Dissolved	0.006	N/A*
Zinc	Dissolved	1.50	N/A*
Organics (ug/L)			
Bis(2-ethylhexyl)phthalate	Total	34.0	N/A*
Di-n-butylphthalate	Total	48.0	N/A*
Phenanthrene	Total	6.00	N/A*
Phenol	Total	5,000	N/A*
SE AEU			
No ECOPCs			

N/A = No data available
N/A* = Not enough samples available to calculate a UTL

Table 3.2
Sediment Exposure Point Concentrations

ECOPC	Sediment EPC (Entire Sediment Column)	Sediment EPC (Surface Sediment; 0 - 6")
RC AEU		
No ECOPCs		
MK AEU		
Inorganics (mg/l)		
Aluminum	30,003	30,300
Antimony	12.4	12.4
Chromium	44.3	44.3
Fluoride	8.47	8.47
Nickel	28.3	28.3
Selenium	2.70	2.70
Organics (ug/l)		
Total PAHs	2,400	9,600
4-Methylphenol	95.0	95.0
NN AEU		
Inorganics (mg/l)		
Aluminum	24,000	24,000
Barium	390	350
Iron	21,500	21,500
Lead	37.6	29.3
Organics (ug/l)		
Benzo(a)anthracene	150	150
Benzo(a)pyrene	160	160
Benzo(g,h,i)perylene	89.0	0.890
Chrysene	190	190
Indeno(1,2,3-cd)pyrene	86.0	86.0
Phenanthrene	280	280
Pyrene	320	320
Total PAHs	4,573	5,883
SE AEU		
No ECOPCs		

Table 4.1
Chronic and Acute ESLs for Surface Water ECOPCs

ECOPC	Units	No Name		Rock Creek		McKay ditch		Southeast		Reference
		ESL	Acute	ESL	Acute	ESL	Acute	ESL	Acute	
Inorganic										
Aluminum (D)	µg/L	750	N/A	N/A	N/A	750	N/A	N/A	N/A	CDPHE 2005a
Ammonia (unionized)	µg/L	20	162	N/A	N/A	N/A	N/A	N/A	N/A	CDPHE 2005a
Barium (T)	µg/L	1204	6870	N/A	N/A	N/A	N/A	N/A	N/A	Tier 2; MIDEQ 2003
Cadmium (D)	µg/L	N/A	N/A	N/A	N/A	0.15	1.05	N/A	N/A	CDPHE 2005a
Iron (T)	µg/L	N/A	N/A	N/A	N/A	1000	N/A	N/A	N/A	CDPHE 2005a
Lead (D)	µg/L	6.97	N/A	N/A	N/A	1.21	31.0	N/A	N/A	CDPHE 2005a
Selenium (D)	µg/L	N/A	N/A	N/A	N/A	4.6	18.4	N/A	N/A	CDPHE 2005a
Silver (D)	µg/L	1.65	N/A	N/A	N/A	0.10	0.64	N/A	N/A	CDPHE 2005a
Zinc (D)	µg/L	262	N/A	N/A	N/A	67	67	N/A	N/A	CDPHE 2005a
Organic										
bis(2-ethylhexyl)phthalate	µg/L	28.5	285	N/A	N/A	N/N	N/A	N/A	N/A	Tier 2; MIDEQ 2003
Di-n-butylphthalate	µg/L	9.7	75	N/A	N/A	N/N	N/A	N/A	N/A	Tier 2; MIDEQ 2003
Pentachlorophenol	µg/L	13.7	35.7	N/A	N/A	N/N	N/A	N/A	N/A	CDPHE 2005a
Phenol	µg/L	2560	10200	N/A	N/A	N/N	N/A	N/A	N/A	CDPHE 2005a

AWQC - Ambient Water Quality Criteria
Tier 2 - Tier 2 Ambient Water Quality Criteria
WQC - Water Quality Criteria
Hardness dependant criteria were calculated based on AEU - specific hardness
Site -specific water qualtiy parameters presented in Table A5.3
Ammonium NAWQC were calculated based on site specific pH and temperature = 20°C.
PCB Value is for total PCBs.
N/A = Not applicable or not available.
(T) = Total
(D) = Dissolved

Table 4.2
Sediment Toxicity Reference Values

ECOPC	NOEC ESL	NOEC Type	LOEC Value	LOEC TYPE
Inorganics (mg/kg)				
Aluminum	1.62	SQG	0.445	ERM
Antimony	13.2	SQG	8.22	SLCA
Barium	1.20	SQG	0.793	SQG
Chromium	43.4	CB-TEC	111	CB-PEC
Iron	1.30	LEL	0.093	ERM
Lead	1.13	CB-TEC	0.317	CB-PEC
Nickel	1.10	CB-TEC	0.514	CB-PEC
Selenium	1.89	SQG	1.04	SQG
Fluoride	1,672	CB-TEC	2.39	TET
Organics (ug/kg)				
Total PAHs	7.45	CB-TEC	0.526	CB-PEC
4-Methylphenol	12.3	EqP	670	WS-SQS
Benzo(a)anthracene	8.15	CB-TEC	0.838	CB-PEC
Benzo(a)pyrene	6.13	CB-TEC	0.634	CB-PEC
Benzo(g,h,i)perylene	61.5	ERL	2.86	ERM
Chrysene	4.93	CB-TEC	0.634	CB-PEC
Phenanthrene	7.35	CB-TEC	1.28	CB-PEC
Pyrene	7.69	CB-TEC	0.987	CB-PEC

Note: NOEC ESLs may also be representative of threshold-level effects.
CB-PEC = concensus-based probable effect concentration.
CB-TEC = concensus-based threshold effect concentration.
EqP = SW ESL * Koc * foc ; foc estimated at 1%.
ERL = Effects Range Low.
ERM = Effects Range Moderate.
ISQG = Interim Sediment Quality Guideline.
LEL = Lowest Effect Level.
MENVIQ/EC = Ministere de l'Environnement du Quebec / Environment Canada.
PEL = Probable Effect Level.
SCV = secondary chronic value.
SLCA = Screening Level Concentration Approach (minimum effect criteria).
SQAL = Sediment Quality Advisory Level (based on 1% foc).
SQG = Sediment Quality Guideline.
TEL = Threshold Effects Level.
TET = Toxic Effect Threshold at 1% OC.
WS-SQS = Washington State Sediment Quality Standard.
Full references are provided in Attachment 5

Table 5.1
RC AEU Weight of Evidence Conclusions

	Aquatic Community Endpoint										Waterfowl and Wading Birds	
	Sediment LOEC Exceedance[a]	Risk-Based Conclusion	Surface Water Chronic ESL	Risk-Based Conclusion	Surface Water Acute AWQC	Risk-Based Conclusion	Sediment Toxicity	Risk-Based Conclusion	Surface Water Toxicity	Risk-Based Conclusion	DOE (1996)	Risk-Based Conclusion
AEU-wide	No ECOPCs	No site-related risk is predicted.	No ECOPCs	No site-related risk is predicted	No ECOPCs	No site-related risk is predicted	No sediment toxicity data were available.	N/A	No surface water toxicity data were available	N/A	No risks specific to RC AEU were calculated in DOE (1996). However, chemical concentrations in RC AEU for all of the chemicals discussed as risk drivers in DOE (1996) are lower than concentrations predicted to be representative of low risks.	Low risk to this endpoint is predicted. Moderate uncertainty based on lack of data specific to RC AEU.

Table 5.2
Hazard Quotient Evaluation of Surface Water ECOPCs in the MK AEU

ECOPC	Chronic ESL[a]	Acute Criterion[a]	Units	Number of Samples	95 UTL EPC Hazard Quotients			Chronic ESL HQs[b]					Acute HQs[b]				
					EPC-95UTL	ESL-HQ	Acute-HQ	<= 1	> 1 - 5	> 5 - 10	> 10	% HQ > 1	<= 1	> 1 - 5	> 5 - 10	> 10	% HQ > 1
Inorganic (mg/L)																	
Aluminum-Total	0.0870	N/A	mg/L	39	17.7	200	N/A	0	8	3	28	100	N/A	N/A	N/A	N/A	N/A
Cadmium-Dissolved	1.55E-04	0.00105	mg/L	26	0.00300	19	2.9	0 (6)	3 (3)	1 (9)	1 (3)	19 (58)	4 (11)	1 (10)	0	0	4 (39)
Iron-Total	1	N/A	mg/L	38	13.9	14	N/A	10	20	6	2	74	N/A	N/A	N/A	N/A	N/A
Zinc-Dissolved	0.0671	0.0666	mg/L	26	0.245	3.7	3.7	18 (4)	4	0	0	15	18 (4)	4	0	0	15

Note: Cadmium (dissolved) and zincr (dissolved) are hardness-dependent AWQCs. The average hardness for MK AEU (51 mg/L) was used to calculate the values.
N/A - Not available or not applicable.
Numbers in parentheses indicate non-detected samples.
[a] Basis of chronic ESLs and acute criteria provided on Table 4.1.
[b] HQs in these columns calculated on an individual sample basis.

Table 5.3
Hazard Quotient Evaluation of Surface Water ECOPCs in the MK AEU - Post 1999 Data

ECOPC	Chronic ESL[a]	Acute Criterion[a]	Units	Number of Samples	95 UTL EPC Hazard Quotients			Chronic ESL HQs[b]					Acute HQs[b]				
					EPC-95UTL	ESL-HQ	Acute-HQ	<= 1	> 1 - 5	> 5 - 10	> 10	% HQ > 1	<= 1	> 1 - 5	> 5 - 10	> 10	% HQ > 1
Organic (ug/L)																	
Aluminum-Total	0.0870	N/A	mg/L	2	1.7	20	N/A	0	1	0	1	100	N/A	N/A	N/A	N/A	N/A
Iron-Total	1	N/A	mg/L	2	2.8	2.8	N/A	1	1	0	0	50	N/A	N/A	N/A	N/A	N/A

N/A - Not available or not applicable.

[a] Basis of chronic ESLs and acute criteria provided on Table 4.1.

[b] HQs in these columns calculated on an individual sample basis.

Table 5.4
Hazard Quotient Evaluation of Sediment ECOPCs in the MK AEU

ECOPC	NOEC ESL[a]	LOEC[a]	Units	Number of Samples	95 UTL EPC Hazard Quotients			NOEC ESL HQs[b]					LOEC HQs[b]				
					EPC-95UTL	NOEC ESL-HQ	LOEC-HQ	<= 1	> 1 - 5	> 5 - 10	> 10	% HQ > 1	<= 1	> 1 - 5	> 5 - 10	> 10	% HQ > 1
Inorganic																	
Aluminum	15,900	58,000	mg/kg	12	30,003	2	0.5	9	3	0	0	25	12	0	0	0	0
Chromium	43.4	111	mg/kg	12	44.3	1	0.4	11	1	0	0	8	12	0	0	0	0
Fluoride	0.0100	7	mg/kg	1	8.47	800	1	0	0	0	1	100	0	1	0	0	100
Nickel	22.7	48.6	mg/kg	12	28.3	1	0.6	10 (1)	1	0	0	8	11 (1)	0	0	0	0
Selenium	0.950	1.73	mg/kg	12	2.70	3	2	0 (11)	1	0	0	8	0 (11)	1	0	0	8.00
Organic																	
Total PAHs	1,610	22,800	ug/kg	8	2,964	2	0.1	0	1 (6)	1	0	25	2 (6)	0	0	0	0

Note: NOEC ESL may be representative of a threshold value.
Numbers in parentheses indicate non-detected samples.
[a] Basis of NOEC ESL and LOEC values presented in Table 4.2.
[b] HQs in these columns calculated on an individual sample basis.

Table 5.5
Hazard Quotient Evaluation of Surface Sediment ECOPCs in the MK AEU

ECOPC	NOEC ESL[a]	LOEC[a]	Units	Number of Samples	95 UTL EPC Hazard Quotients			NOEC ESL HQs[b]					LOEC HQs[b]				
					EPC-95UTL	NOEC ESL-HQ	LOEC-HQ	<= 1	> 1 - 5	> 5 - 10	> 10	% HQ > 1	<= 1	> 1 - 5	> 5 - 10	> 10	% HQ > 1
Inorganic (mg/kg)																	
Aluminum	15,900	58,000	mg/kg	10	30,003	2	0.5	8	2	0	0	20	10	0	0	0	0
Chromium	43.4	111	mg/kg	10	44.3	1	0.4	9	1	0	0	10	10	0	0	0	0
Fluoride	0.0100	7	mg/kg	1	8.47	800	1	0	0	0	1	100	0	1	0	0	100
Nickel	22.7	48.6	mg/kg	10	28.3	1	0.6	8 (1)	1	0	0	10	9 (1)	0	0	0	0
Selenium	0.950	1.73	mg/kg	10	2.70	3	2	0 (9)	1	0	0	10	0 (9)	1	0	0	10
Organic (ug/kg)																	
Total PAHs	1,610	22,800	ug/kg	8	2,964	2	0.1	0	2 (5)	0 (1)	0	25 (75)	2 (6)	0	0	0	0

Note: NOEC ESL may be representative of a threshold value.
Numbers in parentheses indicate non-detected samples.
[a] Basis of NOEC ESL and LOEC values presented in Table 4.2.
[b] HQs in these columns calculated on an individual sample basis.

Table 5.6
MK AEU Weight of Evidence Conclusions

	Aquatic Community Endpoint										Waterfowl and Wading Birds	
	Sediment LOEC Exceedance[a]	**Risk-Based Conclusion**	**Surface Water Chronic ESL**	**Risk-Based Conclusion**	**Surface Water Acute AWQC**	**Risk-Based Conclusion**	**Sediment Toxicity**	**Risk-Based Conclusion**	**Surface Water Toxicity**	**Risk-Based Conclusion**	**DOE (1996)**	**Risk-Based Conclusion**
AEU-wide	All Sediment - Fluoride (100%; 1 sample available) - Selenium (8%; 1 exceedance) Surface Sediment - Fluoride (100%; 1 sample available) - Selenium (10%; 1 exceedance)	Low percentages of exceedances in AEU-wide sediment samples indicate that while some concentrations of analytes may be elevated in isolated locations, population level risks are likely to be low. Fluoride data are limited spatially.	All surface water - Aluminum (100%) - Cadmium (19%) - Iron (74%) - Zinc (15%) Post-1999 surface water - Aluminum (100%; 2 samples) - Cadmium (N/A) - Iron (50%; 2 samples) - Zinc (N/A)	Risks are likely to be low or uncertain for all ECOPCs. Uncertainties related to temporal coverage were noted for cadmium and zinc. Uncertainties in data quality were noted for cadmium. The lack of perennial aquatic habitat is likely to play a role in limiting potential risk.	All surface water - Aluminum (N/A%) - Cadmium (4%) - Iron (N/A%) - Zinc (15%) Post-1999 surface water - Aluminum (N/A) - Cadmium (N/A) - Iron (N/A) - Zinc (N/A)	Risks are likely to be low or uncertain for all ECOPCs. Uncertainties related to temporal coverage were noted for cadmium and zinc. The lack of perennial aquatic habitat is likely to play a role in limiting potential risk.	No sediment toxicity data were available.	N/A	No surface water toxicity data were available	N/A	No risks specific to MK AEU were calculated in DOE (1996). However, chemical concentrations in MK AEU for all of the chemicals discussed as risk drivers in DOE (1996) are lower than concentrations predicted to be representative of low risks.	Low risk to this endpoint is predicted. Moderate uncertainty based on lack of data specific to MK AEU.
No Ponds Present. No Analysis Conducted.												

a Exceedances are shown as % of samples for AEU-wide and number samples for ponds.

Table 5.7
Hazard Quotient Evaluation of Surface Water ECOPCs in the NN AEU

ECOPC	Chronic ESL[a]	Acute Criterion[a]	Units	Number of Samples	95 UTL EPC Hazard Quotients			Chronic ESL HQs[b]					Acute HQs[b]				
					EPC-95UTL	ESL-HQ	Acute-HQ	<= 1	> 1 - 5	> 5 - 10	> 10	% HQ > 1	<= 1	> 1 - 5	> 5 - 10	> 10	% HQ > 1
Inorganic (mg/L)																	
Ammonia (un-ionized) Total	0.0200	0.162	mg/L	3	0.0216	1.1	0.13	0 (2)	1	0	0	33.3	1 (2)	0	0	0	0
Barium-Total	1.20	6.87	mg/L	58	0.643	0.53	0.094	58	0	0	0	0	58	0	0	0	0
Lead-Dissolved	0.00700	0.180	mg/L	32	0.00260	0.37	0.014	5 (27)	0	0	0	0	5 (27)	0	0	0	0
Selenium-Dissolved	0.00460	0.0184	mg/L	32	0.0125	2.7	0.68	0 (29)	2	1	0	9	2 (29)	1	0	0	3
Silver-Dissolved	0.00166	0.0105	mg/L	32	0.00610	3.7	0.58	0 (11)	4 (16)	1	0	16 (50)	4 (27)	1	0	0	3
Zinc-Dissolved	0.265	0.263	mg/L	31	1.50	5.7	5.7	14 (8)	6	3	0	29	14 (8)	6	3	0	29
Organic (ug/L)																	
bis(2-ethylhexyl)phthalate-Total	28.5	285	ug/L	22	34	1.2	0.12	8 (13)	1	0	0	5	9 (13)	0	0	0	0
Di-n-butylphthalate-Total	9.70	75	ug/L	22	48	4.9	0.64	3 (18)	1	0	0	5	4 (18)	0	0	0	0
Phenanthrene-Total	2.40	43	ug/L	23	6	2.5	0.14	0	6 (16)	0	0 (1)	26 (74)	6 (16)	0 (1)	0	0	0 (4)
Phenol-Total	2,560	10,200	ug/L	27	5,000	2.0	0.49	2 (24)	1	0	0	4	3 (24)	0	0	0	0

Note: barium (total), lead (dissolved), silver (dissolved), and zinc (dissolved) are hardness-dependent AWQCs. The average hardness for NN AEU (259 mg/L) was used to calculate the values.
N/A - Not available or not applicable.
Numbers in parentheses indicate non-detected samples.

[a] Basis of chronic ESLs and acute criteria provided on Table 4.1.

[b] HQs in these columns calculated on an individual sample basis.

Table 5.8
Hazard Quotient Evaluation of Surface Water ECOPCs in the NN AEU - Post 1999 Data

ECOPC	Chronic ESL[a]	Acute Criterion[a]	Units	Number of Samples	95 UTL EPC Hazard Quotients			Chronic ESL HQs[b]					Acute HQs[b]				
					EPC-95UTL	ESL-HQ	Acute-HQ	<= 1	> 1 - 5	> 5 - 10	> 10	% HQ > 1	<= 1	> 1 - 5	> 5 - 10	> 10	% HQ > 1
Inorganic (mg/L)																	
Barium-Total	1.20	6.87	mg/L	24	0.820	0.68	0.12	24	0	0	0	0	24	0	0	0	0
Lead-Dissolved	0.00700	0.180	mg/L	1	0	0	0	0 (1)	0	0	0	0	0 (1)	0	0	0	0
Selenium-Dissolved	0.00460	0.0184	mg/L	1	0	0	0	0 (1)	0	0	0	0	0 (1)	0	0	0	0
Silver-Dissolved	0.00166	0.0105	mg/L	1	0	0	0	0 (1)	0	0	0	0	0 (1)	0	0	0	0
Zinc-Dissolved	0.265	0.263	mg/L	1	0.0140	0.053	0.053	1	0	0	0	0	1	0	0	0	0
Organic (mg/L)																	
bis(2-ethylhexyl)phthalate-Total	28.5	285	ug/L	2	0	0	0	0 (2)	0	0	0	0	0 (2)	0	0	0	0
Di-n-butylphthalate-Total	9.70	75	ug/L	2	0	0	0	0 (2)	0	0	0	0	0 (2)	0	0	0	0
Phenanthrene-Total	2.40	43	ug/L	2	3.50	1.5	0.081	0	1 (1)	0	0	50 (50)	1 (1)	0	0	0	0
Phenol-Total	2,560	10,200	ug/L	2	3.50	0.0014	0.00034	1 (1)	0	0	0	0	1 (1)	0	0	0	0

Note: Barium (total), lead (dissolved), silver (dissolved) and zinc (dissolved) are hardness-dependent AWQCs. The average hardness for NN AEU (259 mg/L) was used to calculate the values.
N/A - Not available or not applicable.
Numbers in parentheses indicate non-detected samples.
[a] Basis of chronic ESLs and acute criteria provided on Table 4.1.
[b] HQs in these columns calculated on an individual sample basis.

Table 5.9
Hazard Quotient Evaluation of Sediment ECOPCs in the NN AEU

ECOPC	NOEC ESL[a]	LOEC[a]	Units	Number of Samples	95 UTL EPC Hazard Quotients			NOEC ESL HQs[b]					LOEC HQs[b]				
					EPC-95UTL	NOEC ESL-HQ	LOEC-HQ	<= 1	> 1 - 5	> 5 - 10	> 10	% HQ > 1	<= 1	> 1 - 5	> 5 - 10	> 10	% HQ > 1
Inorganic (mg/kg)																	
Aluminum	15,900	58,000	mg/kg	20	24,000	2	0.4	11	9	0	0	45	20	0	0	0	0
Barium	189	287	mg/kg	20	390	2	1	12	8	0	0	40	17	3	0	0	15
Iron	20,000	280,000	mg/kg	20	21,500	1	0.1	18	2	0	0	10	20	0	0	0	0
Lead	35.8	128	mg/kg	20	37.6	1	0.3	19	1	0	0	5	20	0	0	0	0
Organic (ug/kg)																	
Benzo(a)anthracene	108	1,050	ug/kg	16	150	1	0.1	4	2 (10)	0	0	13 (63)	6 (10)	0	0	0	0
Benzo(a)pyrene	150	1,450	ug/kg	16	160	1	0.1	1	1 (14)	0	0	6 (88)	2 (14)	0	0	0	0
Benzo(g,h,i)perylene	13	280	ug/kg	16	89	7	0.3	0	0	2	0 (14)	13 (87)	2 (5)	0 (9)	0	0	0 (56)
Chrysene	166	1,290	ug/kg	16	190	1	0.1	3	1 (12)	0	0	6 (75)	4 (12)	0	0	0	0
Indeno(1,2,3-cd)pyrene	17	250	ug/kg	16	86	5	0.3	0	1	1 (1)	0 (13)	13 (87)	2 (5)	0 (9)	0	0	0 (56)
Phenanthrene	204	1,170	ug/kg	16	280	1	0.2	5 (3)	1 (7)	0	0	6 (44)	6 (10)	0	0	0	0
Pyrene	195	1,520	ug/kg	16	320	2	0.2	0 (3)	2 (11)	0	0	13(69)	2 (14)	0	0	0	0
Total PAHs	1,610	22,800	ug/kg	16	5,129	3	0.2	0	7 (9)	0	0	44 (56)	7 (9)	0	0	0	0

Note: NOEC ESL may be representative of a threshold value.
Numbers in parentheses indicate non-detected samples.
[a] Basis of NOEC ESL and LOEC values presented in Table 4.2.
[b] HQs in these columns calculated on an individual sample basis.

Table 5.10
Hazard Quotient Evaluation of Surface Sediment ECOPCs in the NN AEU

ECOPC	NOEC ESL[a]	LOEC[a]	Units	Number of Samples	95 UTL EPC Hazard Quotients			NOEC ESL HQs[b]					LOEC HQs[b]				
					EPC-95UTL	NOEC ESL-HQ	LOEC-HQ	<= 1	> 1 - 5	> 5 - 10	> 10	% HQ > 1	<= 1	> 1 - 5	> 5 - 10	> 10	% HQ > 1
Inorganic (mg/kg)																	
Aluminum	15,900	58,000	mg/kg	17	24,000	2	0.4	8	9	0	0	53	17	0	0	0	0
Barium	189	287	mg/kg	17	390	2	1	9	8	0	0	47	14	3	0	0	18
Iron	20,000	280,000	mg/kg	17	21,500	1	0.1	15	2	0	0	12	17	0	0	0	0
Lead	35.8	128	mg/kg	17	29.3	0.8	0.2	17	0	0	0	0	17	0	0	0	0
Organic (ug/kg)																	
Benzo(a)anthracene	108	1,050	ug/kg	15	150	1	0.1	4	2 (9)	0	0	13 (60)	6 (9)	0	0	0	0
Benzo(a)pyrene	150	1,450	ug/kg	15	160	1	0.1	1	1 (13)	0	0	7 (87)	2 (13)	0	0	0	0
Benzo(g,h,i)perylene	13	280	ug/kg	15	89	7	0.3	0	0	2	0 (13)	13 (87)	2 (4)	0 (9)	0	0	0 (60)
Chrysene	166	1,290	ug/kg	15	190	1	0.1	3	1 (11)	0	0	7 (73)	4 (11)	0	0	0	0
Indeno(1,2,3-cd)pyrene	17	250	ug/kg	15	86	5	0.3	0	1	1 (1)	0 (12)	13 (87)	2 (4)	0 (9)	0	0	0 (60)
Phenanthrene	204	1,170	ug/kg	15	280	1	0.2	5 (3)	1 (6)	0	0	7 (40)	6 (9)	0	0	0	0
Pyrene	195	1,520	ug/kg	15	320	2	0.2	0 (3)	2 (10)	0	0	13 (67)	2 (13)	0	0	0	0
Total PAHs	1,610	22,800	ug/kg	15	5,129	3	0.2	0	7 (8)	0	0	47 (53)	7 (8)	0	0	0	0

Note: NOEC ESL may be representative of a threshold value.

Numbers in parentheses indicate non-detected samples.

[a] Basis of NOEC ESL and LOEC values presented in Table 4.2.

[b] HQs in these columns calculated on an individual sample basis.

Table 5.11
NN AEU Weight of Evidence Conclusions

	Aquatic Community Endpoint										Waterfowl and Wading Birds	
	Sediment LOEC Exceedance[a]	**Risk-Based Conclusion**	**Surface Water Chronic ESL**	**Risk-Based Conclusion**	**Surface Water Acute AWQC**	**Risk-Based Conclusion**	**Sediment Toxicity**	**Risk-Based Conclusion**	**Surface Water Toxicity**	**Risk-Based Conclusion**	**DOE (1996)**	**Risk-Based Conclusion**
AEU-wide	All Sediment - Barium (15%; all samples had HQs = 1) Surface Sediment None	Low percentages of exceedances in AEU-wide sediment samples indicate that while some concentrations of analytes may be slightly elevated in subsurface sediments, population level risks are likely to be low.	All surface water -Ammonia (33%; 3 available samples) - Silver (16%) - Selenium (9%) - Zinc (29%) - Bis(2-ethylhexyl)phthalate (5%) - Di-n-butylphthalate (5%_ - Phenanthrene (26%) - Phenol (4%) Post-1999 surface water - Phenol (50%; 2 samples)	Risks are likely to be low or uncertain for all ECOPCs. Uncertainties related to temporal coverage were noted for all ECOPCs except barium (total) Uncertainties in data quality were noted for silver and phenanthrene due to elevated proxy values for non-detects. The lack of perennial aquatic habitat outside of the ELP is likely to play a role in limiting potential risk.	All surface water - Selenium (3%) - Silver (3%) - Zinc (29%) Post-1999 surface water None	Risks are likely to be low or uncertain for all ECOPCs. Uncertainties related to temporal coverage were noted for selenium, silver and zinc.. The lack of perennial aquatic habitat outside of the ELP is likely to play a role in limiting potential risk.	No sediment toxicity data were available.	N/A	No surface water toxicity data were available	N/A	No risks specific to MK AEU were calculated in DOE (1996). However, chemical concentrations in NN AEU for all of the chemicals discussed as risk drivers in DOE (1996) are lower than concentrations predicted to be representative of low risks. Di-n-butylphthalate was detected in excess of concentrations expected to cause risk, however, recent data are all non-detected.	Low risk to this endpoint is predicted. Moderate uncertainty based on lack of data specific to NN AEU.
East Landfill Pond	All Sediment - Barium (3 samples had HQs = 1) Surface Sediment None	Low percentages of exceedances in ELP sediment samples indicate that while some concentrations of analytes may be slightly elevated in subsurface sediments, overall risks are likely to be low.	All surface water - Silver (2) - Bis(2-ethylhexyl)phthalate (1) - Di-n-butylphthalate (1) - Phenol (1) Post-1999 surface water None	Risks are likely to be low or uncertain for all ECOPCs. Uncertainties related to temporal coverage were noted for all ECOPCs. Uncertainties in data quality were noted for silver due to elevated proxy values for non-detects.	All surface water None Post-1999 surface water None	Risks are likely to be low .Uncertainties related to temporal coverage were noted.	No sediment toxicity data were available.	N/A	No surface water toxicity data were available	N/A	No risks specific to MK AEU were calculated in DOE (1996). However, chemical concentrations in NN AEU for all of the chemicals discussed as risk drivers in DOE (1996) are lower than concentrations predicted to be representative of low risks. Di-n-butylphthalate was detected in excess of concentrations expected to cause risk, however, recent data are all non-detected.	Low risk to this endpoint is predicted. Moderate uncertainty based on lack of data specific to NN AEU.

a Exceedances are shown as % of samples for AEU-wide and number samples for ponds.

Table 5.12
SE AEU Weight of Evidence Conclusions

	Aquatic Community Endpoint										Waterfowl and Wading Birds	
	Sediment LOEC Exceedance[a]	Risk-Based Conclusion	Surface Water Chronic ESL	Risk-Based Conclusion	Surface Water Acute AWQC	Risk-Based Conclusion	Sediment Toxicity	Risk-Based Conclusion	Surface Water Toxicity	Risk-Based Conclusion	DOE (1996)	Risk-Based Conclusion
AEU-wide	No ECOPCs	No site-related risk is predicted.	No ECOPCs	No site-related risk is predicted	No ECOPCs	No site-related risk is predicted	No sediment toxicity data were available.	N/A	No surface water toxicity data were available	N/A	No risks specific to SE AEU were calculated in DOE (1996). However, chemical concentrations in SE AEU for all of the chemicals discussed as risk drivers in DOE (1996) are lower than concentrations predicted to be representative of low risks.	Low risk to this endpoint is predicted. Moderate uncertainty based on lack of data specific to SE AEU.

Table 5.13
Hazard Quotient Evaluation of Background Surface Water ECOPCs in the MK AEU, NN AEU, RC AEU, and SE AEU

ECOPC	Chronic ESL[a]	Acute Criterion[a]	Units	Number of Samples	95 UTL EPC Hazard Quotients			Chronic ESL HQs[b]					Acute HQs[b]				
					EPC-95UTL	Chronic ESL-HQ	Acute -HQ	<= 1	> 1 - 5	> 5 - 10	> 10	% HQ > 1	<= 1	> 1 - 5	> 5 - 10	> 10	% HQ > 1
Inorganic (mg/L)																	
Aluminum-Total	0.750	N/A	mg/L	166	9.18	12	N/A	75 (30)	37	12	12	37	N/A	N/A	N/A	N/A	N/A
Barium-Total	10,903	1,911	mg/L	172	0.124	0.000011	0.000065	134 (38)	0	0	0	0	134 (38)	0	0	0	0
Cadmium-Dissolved	0.643	7.74	mg/L	136	0.00250	0.0039	0.00032	10 (126)	0	0	0	0	10 (126)	0	0	0	0
Iron-Total	1	N/A	mg/L	172	5.22	5.2	N/A	106 (6)	45	6	9	35	N/A	N/A	N/A	N/A	N/A
Lead-Dissolved	10.9	281	mg/L	133	0.00370	0.00034	0.000013	32 (101)	0	0	0	0	32 (101)	0	0	0	0
Selenium-Dissolved	0.00460	0.0184	mg/L	133	0.00250	0.54	0.14	8 (121)	2 (2)	0	0	2 (2)	10 (122)	0 (1)	0	0	0 (1)
Silver-Dissolved	3.47	22.0	mg/L	141	0.00500	0.0014	0.00023	8 (133)	0	0	0	0	8 (133)	0	0	0	0
Zinc-Dissolved	382	379	mg/L	138	0.0481	0.00013	0.00013	78 (60)	0	0	0	0	78 (60)	0	0	0	0

Note: Cadmium (dissolved) and silver (dissolved) are hardness-dependent AWQCs. The average hardness for the background dataset was greater than 400 mg/L. Per CDPHE regulations, 400 mg/L was used to calculate the values.
N/A - Not available or not applicable.
Numbers in parentheses indicate non-detected samples.
[a] Basis of chronic ESLs and acute criteria provided on Table 4.1.
[b] HQs in these columns calculated on an individual sample basis.

Table 5.14
Hazard Quotient Evaluation of Background Sediment ECOPCs in the MK AEU, NN AEU, RC AEU, and SE AEU

ECOPC	NOEC ESL[a]	LOEC[a]	Units	Number of Samples	95 UTL EPC Hazard Quotients			NOEC ESL HQs[b]					LOEC HQs[b]				
					EPC-95UTL	NOEC ESL-HQ	LOEC-HQ	<= 1	> 1 - 5	> 5 - 10	> 10	% HQ > 1	<= 1	> 1 - 5	> 5 - 10	> 10	% HQ > 1
Inorganic (mg/kg)																	
Aluminum	15,900	58,000	mg/kg	55	19,400	1	0.3	50	5	0	0	9	55	0	0	0	0
Antimony	2	3.20	mg/kg	47	9.34	5	3	1 (18)	2 (23)	2 (1)	0	9 (51)	2 (27)	3 (15)	0	0	6 (32)
Barium	189	287	mg/kg	54	183	1	0.6	52	2	0	0	4	54	0	0	0	0
Chromium	43.4	111	mg/kg	55	28.2	0.6	0.3	47 (8)	0	0	0	0	47 (8)	0	0	0	0
Iron	20,000	280,000	mg/kg	55	23,400	1	0.1	51	4	0	0	7	55	0	0	0	0
Lead	35.8	128	mg/kg	55	36.8	1	0.3	52	3	0	0	5	55	0	0	0	0
Nickel	22.7	48.6	mg/kg	53	17.6	0.8	0.4	37 (15)	1	0	0	2	38 (15)	0	0	0	0
Selenium	0.950	1.73	mg/kg	54	2	2	1	10 (39)	5	0	0	9	12 (39)	3	0	0	6

Note: NOEC ESL may be representative of a threshold value.
Numbers in parentheses indicate non-detected samples.

[a] Basis of NOEC ESL and LOEC values presented in Table 4.2.

[b] HQs in these columns calculated on an individual sample basis.

Table 6.1
Summary of Surface Water ECOIs Without ESLs

ECOI	NN AEU	RC AEU	MK AEU	SE AEU
Cations/Anions and Inorganics				
Calcium	X	X	X	X
Cerium	N/A	N/A	X	N/A
Cesium	N/A	X	X	X
Magnesium	X	X	X	X
Nitrate/Nitrite	X	X	X	X
Orthophosphate	N/A	X	X	N/A
Phosphate	N/A	X	X	X
Phosphorous	X	X	X	X
Potassium	X	X	X	X
Silica	N/A	X	X	X
Silicon	X	X	X	X
Sodium	X	X	X	X
Sulfate	X	X	X	X
Sulfide	N/A	X	N/A	X
Titanium	N/A	X	X	X
Organics				
1,2,3-Trichloropropane	N/A	N/A	N/A	N/A
2-Methylnaphthalene	X	N/A	N/A	N/A
2-Nitrophenol	N/A	N/A	N/A	N/A
4-Bromophenyl-phenylether	X	N/A	N/A	N/A
4-Chlorotoluene	N/A	N/A	N/A	N/A
4-Isopropyltoluene	X	N/A	N/A	N/A
Acenaphthylene	X	N/A	N/A	N/A
Benzo(b)fluoranthene	N/A	N/A	N/A	N/A
Benzo(g,h,i)perylene	N/A	N/A	N/A	N/A
Benzo(k)fluoranthene	N/A	N/A	N/A	N/A
Chlorodifluoromethane	X	X	N/A	N/A
Chloroethane	X	N/A	N/A	N/A
Chloromethane	X	N/A	N/A	N/A
Dibenz(a,h)anthracene	N/A	N/A	N/A	N/A
Dichlorodifluoromethane	N/A	N/A	N/A	N/A
Di-n-octylphthalate	N/A	N/A	N/A	N/A
Indeno(1,2,3-cd)pyrene	N/A	N/A	N/A	N/A
Isopropylbenzene	N/A	N/A	N/A	N/A
n-Butylbenzene	N/A	N/A	N/A	N/A
n-Propylbenzene	N/A	N/A	N/A	N/A
sec-Butylbenzene	N/A	N/A	N/A	N/A
Trichlorofluoromethane	N/A	N/A	N/A	N/A
Radionuclides				
Curium-244	N/A	X	N/A	N/A
Gross Alpha	X	X	X	X
Gross Beta	X	X	X	X
Neptunium-237	N/A	X	N/A	N/A
Thorium-230	N/A	X	N/A	N/A
Thorium-232	N/A	X	N/A	N/A
Tritium	X	X	X	X
Plutonium-238	X	N/A	X	N/A

X = Indicates ESL is unavailable.
N/A indicates that the ECOI was not analyzed in the AEU

Table 6.2
Summary of Sediment ECOIs Without ESLs

ECOI	NN AEU	RC AEU	MK AEU	SE AEU
Cations/Anions and Inorganics				
Beryllium	X	X	X	X
Boron	X	X	X	X
Calcium	X	X	X	X
Cesium	X	X	X	N/A
Cobalt	X	X	X	X
Lithium	X	X	X	X
Magnesium	X	X	X	X
Molybdenum	X	X	X	X
Nitrate/Nitrite	X	X	X	N/A
Potassium	X	X	X	X
Silica	X	X	X	X
Silicon	X	X	X	N/A
Sodium	X	X	X	X
Strontium	X	X	X	X
Thallium	X	X	X	X
Tin	X	X	X	N/A
Titanium	X	X	X	X
Uranium	N/A	X	X	X
Vanadium	X	X	X	X
Organics				
Acetone	X	X	N/A	N/A
Benzo(b)fluoranthene	X	N/A	N/A	N/A
Benzoic acid	N/A	X	X	N/A
2-Hexanone	N/A	N/A	N/A	N/A
4,6-Dinitro-2-methylphenol	N/A	X	N/A	N/A
4-Nitrophenol	N/A	X	N/A	N/A
Methylene chloride	X	X	N/A	N/A
Radionuclides				
Cesium-134	X	X	X	N/A
Gross Alpha	X	X	X	N/A
Gross Beta	X	X	X	N/A

X = Indicates ESL is unavailable.
N/A indicates that the ECOI was not analyzed in the AEU

Table 6.3
Summary of Uncertain Sediment ECOIs as Compared to Surface Water ECOPCs for NN AEU

Analyte	MDC	% Detect in Sediment	SW ESL Available?	% Detect in Surface Water	> Background in Surface Water	SW ECOPC?	Risk Concern?	Rationale
Inorganics (mg/kg)								
Beryllium	1.2	95	Yes	25	N/A	No	No	Not a SW ECOPC
Boron	10	100	Yes	N/A	N/A	N/A	No	ND
Calcium	74,000	100	No	100	--	N/A	No	CE
Cesium	3.9	13	No	N/A	N/A	N/A	No	UC
Cobalt	11.8	100	Yes	36	--	No	No	Not a SW ECOPC
Lithium	15	94	Yes	96	Yes	No	No	Not a SW ECOPC
Magnesium	4,200	100	No	100	--	N/A	No	CE
Molybdenum	5.2	61	Yes	45	--	No	No	Not a SW ECOPC
Nitrate / Nitrite	3.2	70	No	36	--	N/A	No	UC
Potassium	2,810	95	No	95	--	N/A	No	CE
Silica	2000	100	No	N/A	N/A	N/A	No	CE
Silicon	417	100	No	100	--	N/A	No	CE
Sodium	600	85	No	100	--	N/A	No	UC
Strontium	320	100	Yes	100	--	No	No	Not a SW ECOPC
Thallium	2.3	45	Yes	N/A	N/A	N/A	No	ND
Tin	16.6	28	Yes	11	--	No	No	Not a SW ECOPC
Titanium	150	100	No	N/A	N/A	N/A	No	CE
Vanadium	59	100	Yes	48	No	No	No	BB, Not a SW ECOPC
Organics (µg/kg)								
Acetone	99	62	Yes	15	--	No	No	Not a SW ECOPC
Benzo(b)fluoranthene	190	25	No	N/A	N/A	N/A	No	UC
Methylene Chloride	3.3	62	Yes	28	--	No	No	Not a SW ECOPC
Radionuclides (pCi/g)								
Cesium-134	0.1673	100	No	N/A	N/A	N/A	No	UC
Gross Alpha	37	100	No	100	--	N/A	No	UC
Gross Beta	32	100	No	100	--	N/A	No	UC

BB = Observed sediment or surface water MDC was less than the appropriate background level.
CE = Common element that is associated with low toxicity.
FD = was detected in less than 10% of the surface water or sediment samples.
ND = was not detected in the surface water samples.
Not a SW ECOPC = was not identified as an ECOPC for surface water as per the selection process.
UC = Uncertain toxicity due to a lack of both surface water and sediment ESLs.

Table 6.4
Summary of Uncertain Sediment ECOIs as Compared to Surface Water ECOPCs for RC AEU

Analyte	MDC	% Detect in Sediment	SW ESL Available?	% Detect in Surface Water	> Background in Surface Water	SW ECOPC?	Risk Concern?	Rationale
Inorganics (mg/kg)								
Beryllium	2.10	74	Yes	25	N/A	No	No	Not a SW ECOPC
Boron	17.00	100	Yes	N/A	N/A	N/A	No	N/A
Calcium	61,000	100	No	100	--	N/A	No	CE
Cesium	2.9	7	No	9	N/A	N/A	No	FD
Cobalt	18	95	Yes	31	--	No	No	Not a SW ECOPC
Lithium	20.3	100	Yes	77	Yes	No	No	Not a SW ECOPC
Magnesium	4,100	100	No	99	--	N/A	No	CE
Molybdenum	9.6	20	Yes	40	--	No	No	Not a SW ECOPC
Nitrate / Nitrite	76	67	No	65	--	N/A	No	UC
Potassium	2,900	100	No	94	--	N/A	No	CE
Silica	2,600	100	No	100	--	N/A	No	CE
Silicon	1,480	100	No	100	--	N/A	No	CE
Sodium	413	73	No	100	--	N/A	No	CE
Strontium	179	100	Yes	99	--	No	No	Not a SW ECOPC
Thallium	0.41	11	Yes	3	--	No	No	FD, Not a SW ECOPC
Tin	37.1	32	Yes	10	--	No	No	Not a SW ECOPC
Titanium	170	100	No	33	--	N/A	No	UC
Uranium	7.8	40	Yes	N/A	N/A	N/A	No	ND
Vanadium	57.1	100	Yes	61	No	No	No	BB
Organics (µg/kg)								
Acetone	520	36	Yes	7	--	No	No	FD, Not a SW ECOPC
Benzoic Acid	2,000	35	Yes	N/A	N/A	N/A	No	ND
4,6-Dinitro-2-methylphenol	1100	6	No	N/A	N/A	N/A	No	FD
4-Nitrophenol	1300	6	No	N/A	N/A	N/A	No	FD
Methylene Chloride	300	7	Yes	7	--	No	No	FD, Not a SW ECOPC
Radionuclides (pCi/g)								
Cesium-134	0.26	100	No	N/A	N/A	N/A	No	UC
Gross Alpha	62	100	No	100	--	N/A	No	UC
Gross Beta	54	100	No	100	--	N/A	No	UC

BB = Observed sediment or surface water MDC was less than the appropriate background level.
CE = Common element that is associated with low toxicity.
FD = was detected in less than 10% of the surface water or sediment samples.
ND = was not detected in the surface water samples.
Not a SW ECOPC = was not identified as an ECOPC for surface water as per the selection process.
UC = Uncertain toxicity due to a lack of both surface water and sediment ESLs.

Table 6.5
Summary of Uncertain Sediment ECOIs as Compared to Surface Water ECOPCs for MK AEU

Analyte	MDC	% Detect in Sediment	SW ESL Available?	% Detect in Surface Water	> Background in Surface Water	SW ECOPC?	Risk Concern?	Rationale
Inorganics (mg/kg)								
Beryllium	1.5	83	Yes	N/A	N/A	N/A	No	ND
Boron	6.4	100	Yes	100	--	No	No	Not a SW ECOPC
Calcium	130,000	100	No	100	--	N/A	No	UC, CE
Cesium	4.9	12	No	23	--	N/A	No	UC
Cobalt	9.3	92	Yes	36	--	No	No	Not a SW ECOPC
Lithium	19.2	100	Yes	43	--	No	No	Not a SW ECOPC
Magnesium	4,700	100	No	100	--	N/A	No	CE
Molybdenum	2.4	58	Yes	3	--	No	No	Not a SW ECOPC
Nitrate / Nitrite	64	57	No	85	--	N/A	No	UC
Potassium	2940	100	No	100	--	N/A	No	CE
Silica	970	100	No	100	--	N/A	No	CE
Silicon	854	100	No	100	--	N/A	No	CE
Sodium	2,090	100	No	100	--	N/A	No	CE
Strontium	180	100	Yes	97	--	No	No	Not a SW ECOPC
Thallium	0.4	8	Yes	8	--	No	No	FD, Not a SW ECOPC
Tin	9.3	25	Yes	3	--	No	No	FD, Not a SW ECOPC
Titanium	150	100	No	100	--	N/A	No	UC
Uranium	1.1	25	Yes	50	N/A	No	No	Not a SW ECOPC
Vanadium	67.7	100	Yes	51	No	No	No	BB, Not a SW ECOPC
Organics (µg/kg)								
Benzoic Acid	480	14	No	N/A	N/A	N/A	No	UC
Radionuclides (pCi/g)								
Cesium-134	0.2	100	No	N/A	N/A	N/A	No	UC
Gross Alpha	79	100	No	100	--	N/A	No	UC
Gross Beta	69	100	No	100	--	N/A	No	UC

BB = Observed sediment or surface water MDC was less than the appropriate background level.
CE = Common element that is associated with low toxicity.
FD = was detected in less than 10% of the surface water or sediment samples.
ND = was not detected in the surface water samples.
Not a SW ECOPC = was not identified as an ECOPC for surface water as per the selection process.
UC = Uncertain toxicity due to a lack of both surface water and sediment ESLs.

Table 6.6
Summary of Uncertain Sediment ECOIs as Compared to Surface Water ECOPCs for SE AEU

Analyte	MDC	% Detect in Sediment	SW ESL Available?	% Detect in Surface Water	> Background in Surface Water	SW ECOPC?	Risk Concern?	Rationale
Inorganics (mg/kg)								
Beryllium	1.3	100	Yes	N/A	N/A	N/A	No	ND
Boron	19	100	Yes	75	--	No	No	Not a SW ECOPC
Calcium	55,000	100	No	100	--	N/A	No	CE
Cobalt	8.6	100	Yes	N/A	N/A	N/A	No	ND
Lithium	23	100	Yes	50	--	No	No	Not a SW ECOPC
Magnesium	7,100	100	No	100	--	N/A	No	CE
Molybdenum	1	86	Yes	25	--	No	No	Not a SW ECOPC
Potassium	5,200	100	No	100	--	N/A	No	CE
Silica	2,900	100	No	100	--	N/A	No	CE
Sodium	510	43	No	100	--	N/A	No	CE
Strontium	290	100	Yes	100	--	No	No	Not a SW ECOPC
Thallium	2.6	57	Yes	N/A	N/A	N/A	No	ND
Titanium	260	100	No	25	--	N/A	No	UC
Uranium	2.8	29	Yes	N/A	N/A	N/A	No	ND
Vanadium	62	100	Yes	N/A	N/A	N/A	No	ND

BB = Observed sediment or surface water MDC was less than the appropriate background level.
CE = Common element that is associated with low toxicity.
FD = was detected in less than 10% of the surface water or sediment samples.
ND = was not detected in the surface water samples.
Not a SW ECOPC = was not identified as an ECOPC for surface water as per the selection process.
UC = Uncertain toxicity due to a lack of both surface water and sediment ESLs.

FIGURES

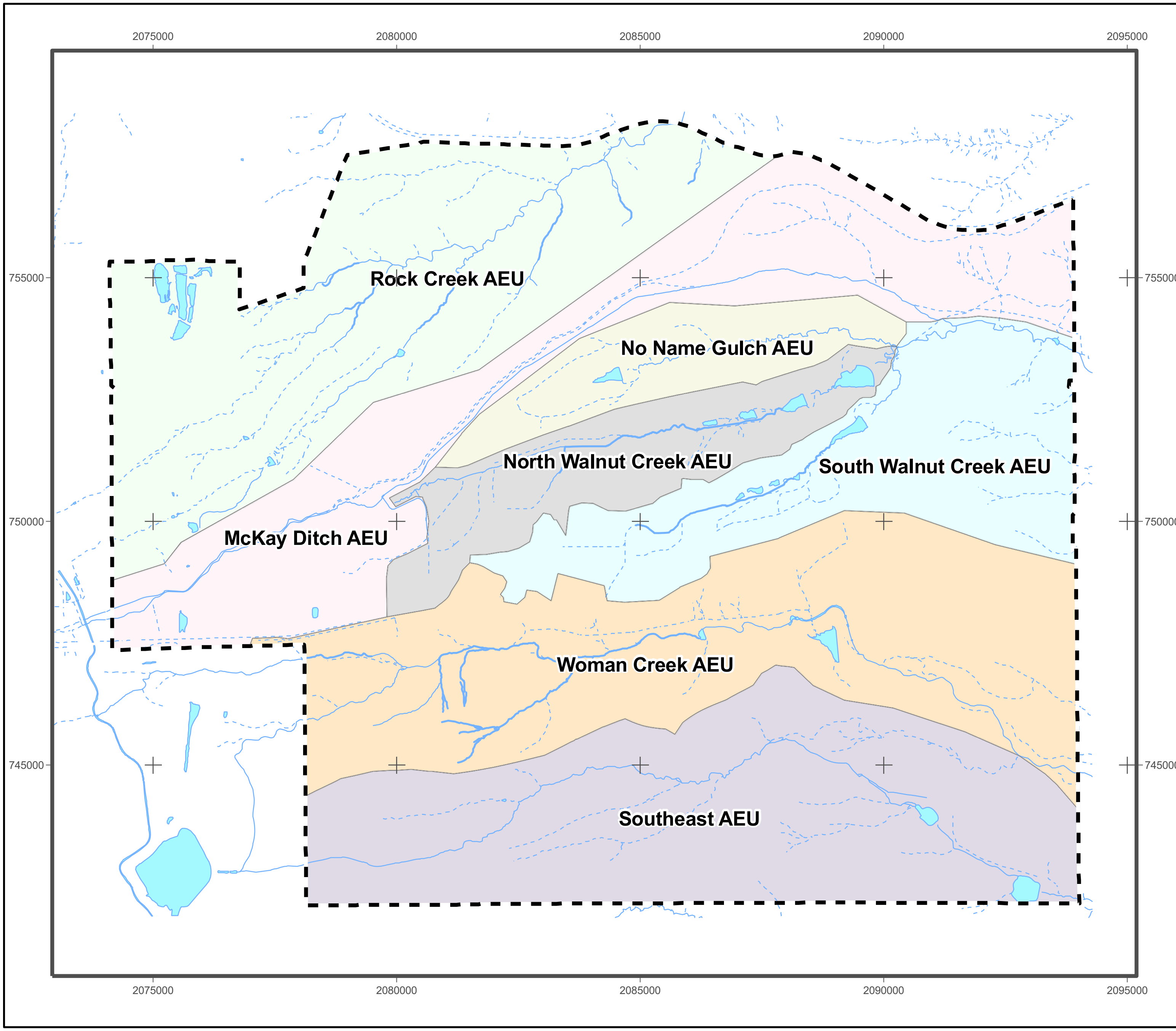

Figure 1.1
Rocky Flats Environmental
Technology Site
Aquatic Exposure Units

KEY

- Aquatic exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Rocky Flats Environmental
Technology Site

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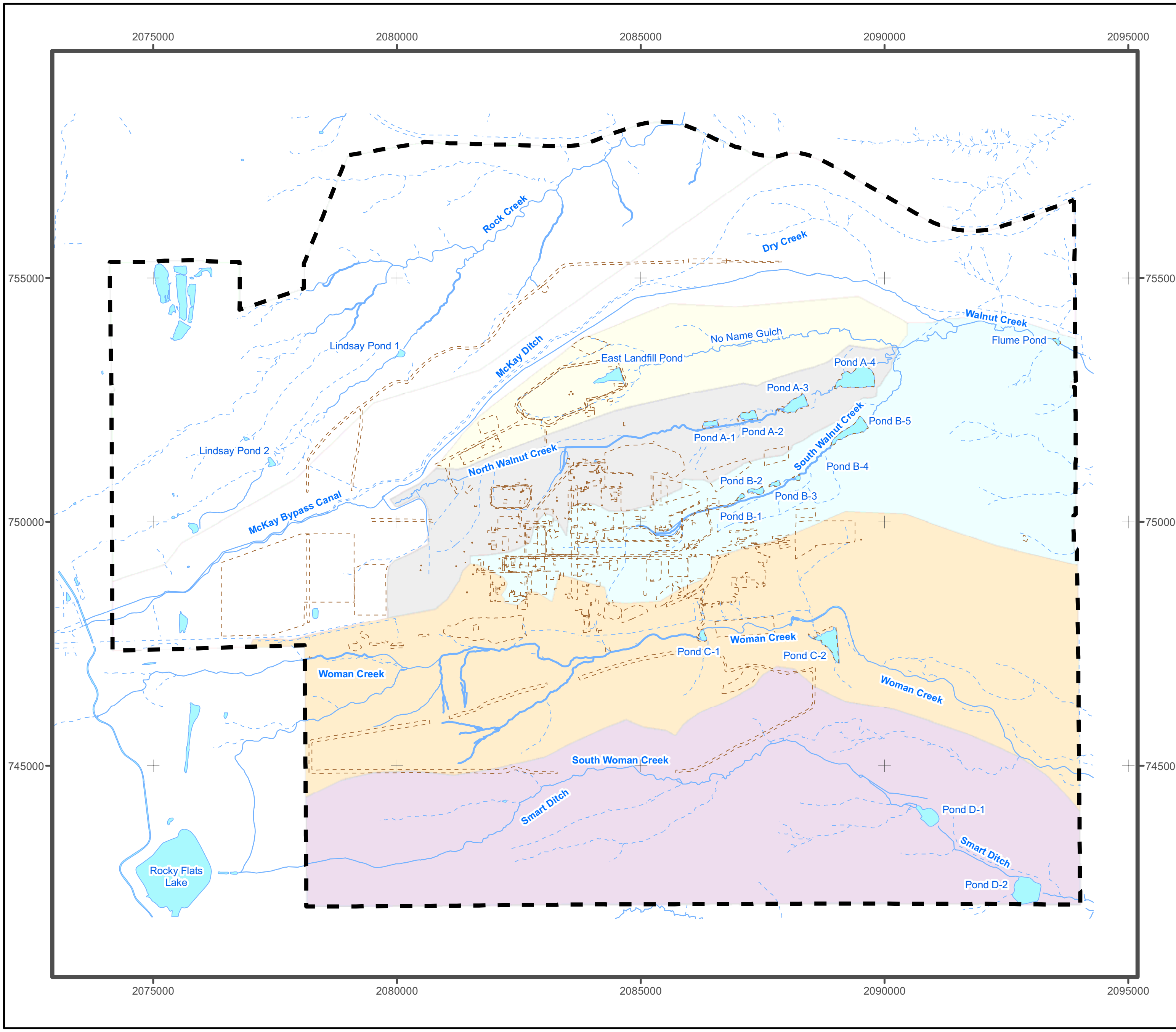

Figure 1.2
IHSS Locations Within
Rocky Flats Environmental
Technology Site

KEY

Historical IHSS/PAC
McKay Ditch AEU
No Name Gulch AEU
North Walnut Creek AEU
Rock Creek AEU
South Walnut Creek AEU
Southeast AEU
Woman Creek AEU

Standard Map Features

Aquatic exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream

N
W
E
S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental
Technology Site

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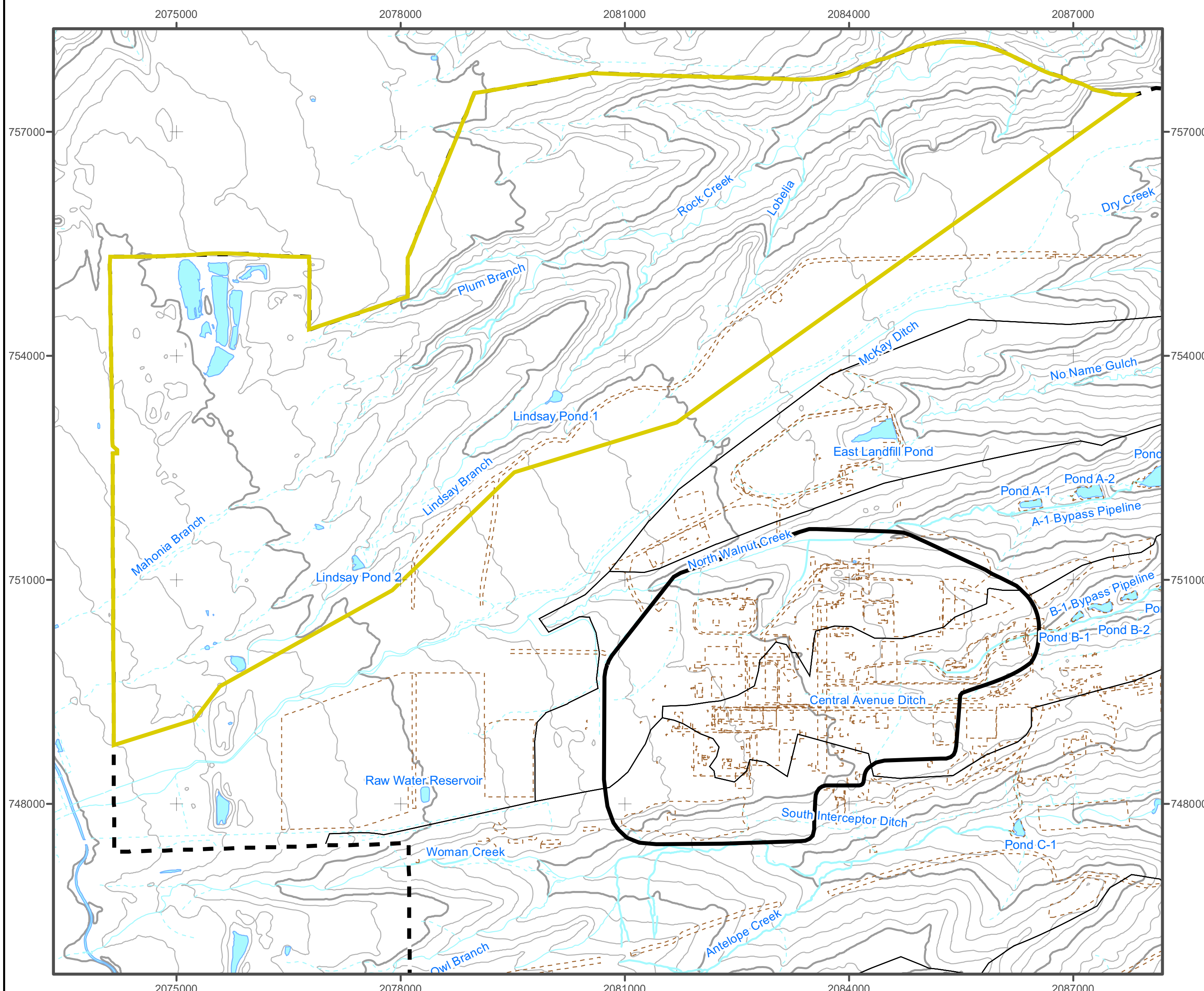
Figure 1.3
Topography and IHSS
Locations in the
Rock Creek AEU



KEY

- Contour line (20 ft)
- Contour line (100 ft)
- Rock Creek AEU
- IA OU boundary
- Historical IHSS/PAC

Standard Map Features

- Aquatic exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 1,000 2,000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental
Technology Site

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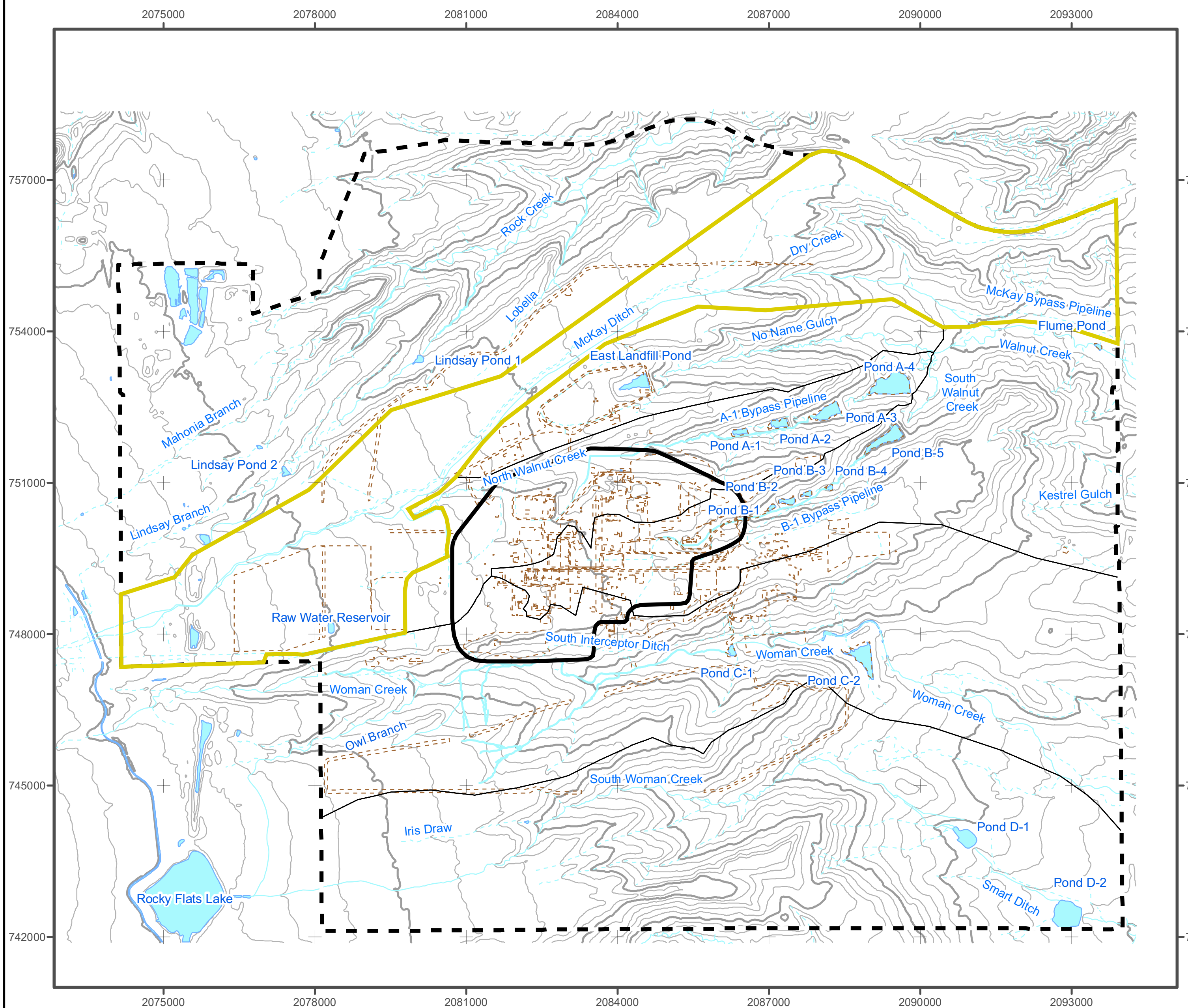
Figure 1.4
Topography and IHSS
Locations in the
McKay Ditch AEU



KEY

- Contour line (20 ft)
- Contour line (100 ft)
- McKay Ditch AEU
- IA OU boundary
- Historical IHSS/PAC

Standard Map Features

- Aquatic exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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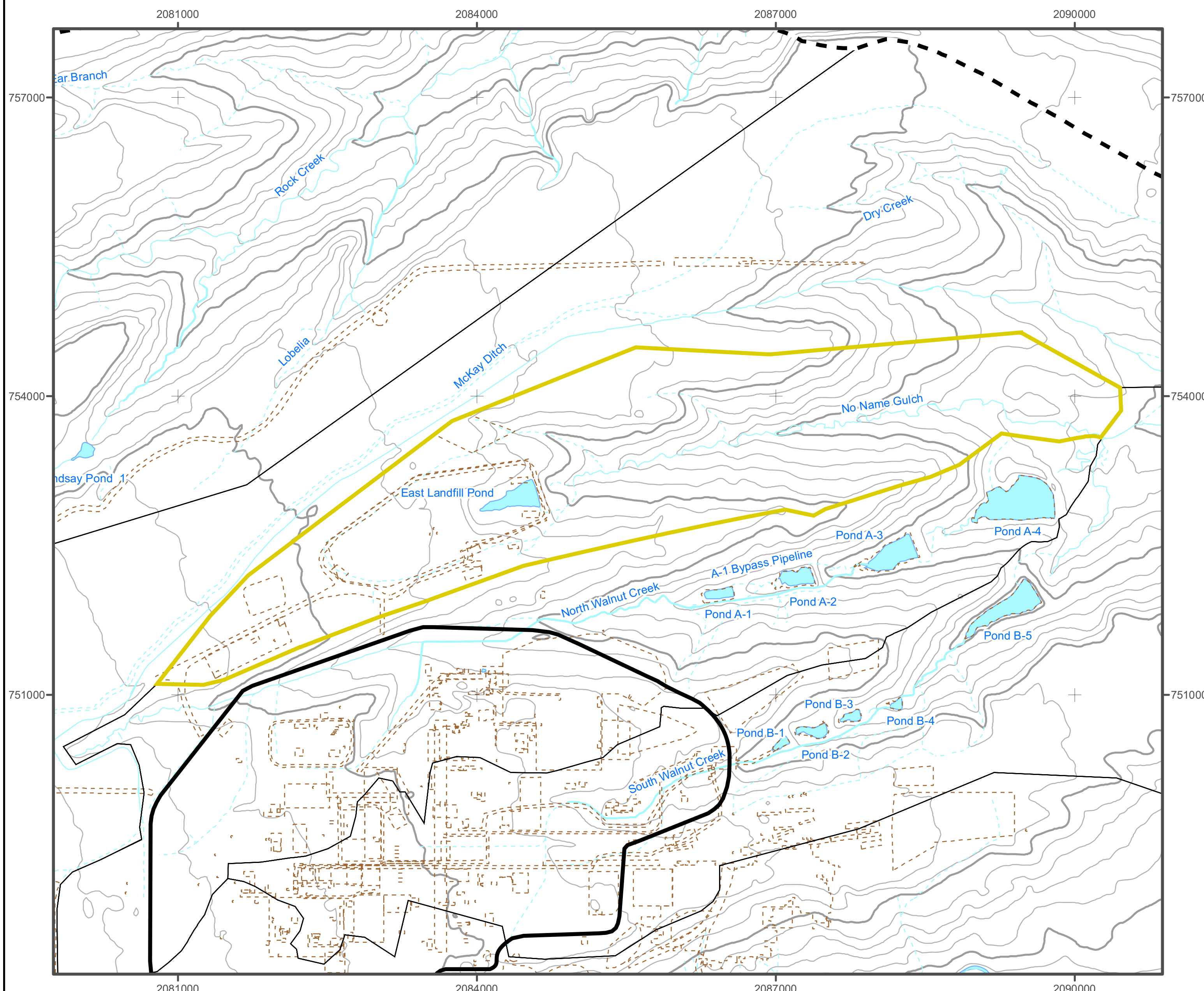

Figure 1.5
Topography and IHSS
Locations in the
No Name Gulch AEU

KEY

Contour line (20 ft)
Contour line (100 ft)
No Name Gulch AEU
IA OU boundary
Historical IHSS/PAC

Standard Map Features

Aquatic exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream

N
W E
S

0 750 1,500 Feet

Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Technology Site

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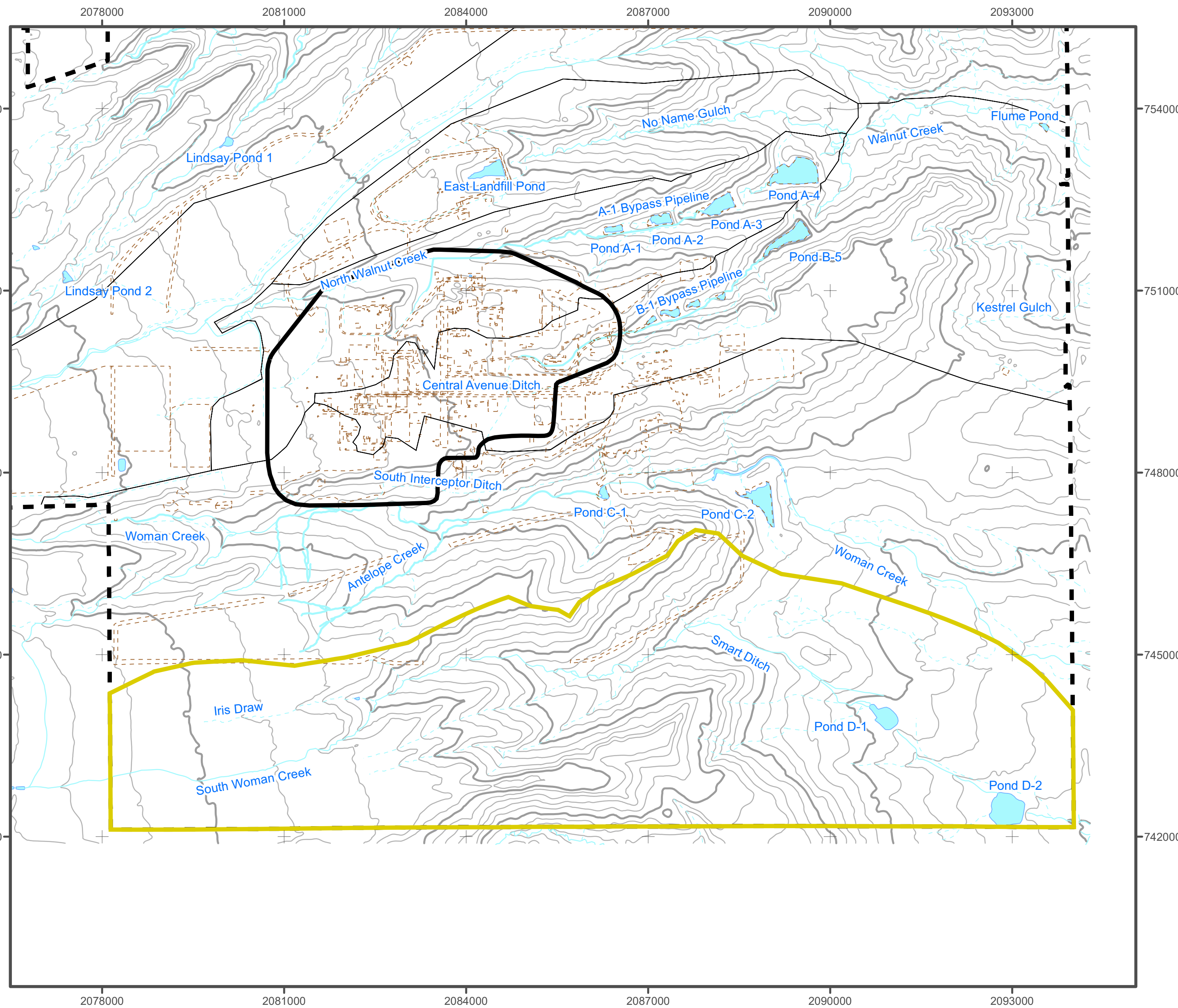

Figure 1.6
Topography and IHSS
Locations in the
Southeast AEU

KEY

- Contour line (20 ft)
- Contour line (100 ft)
- Southeast AEU
- IA OU boundary
- Historical IHSS/PAC

Standard Map Features

- Aquatic exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 1,250 2,500 Feet

Scale 1:30,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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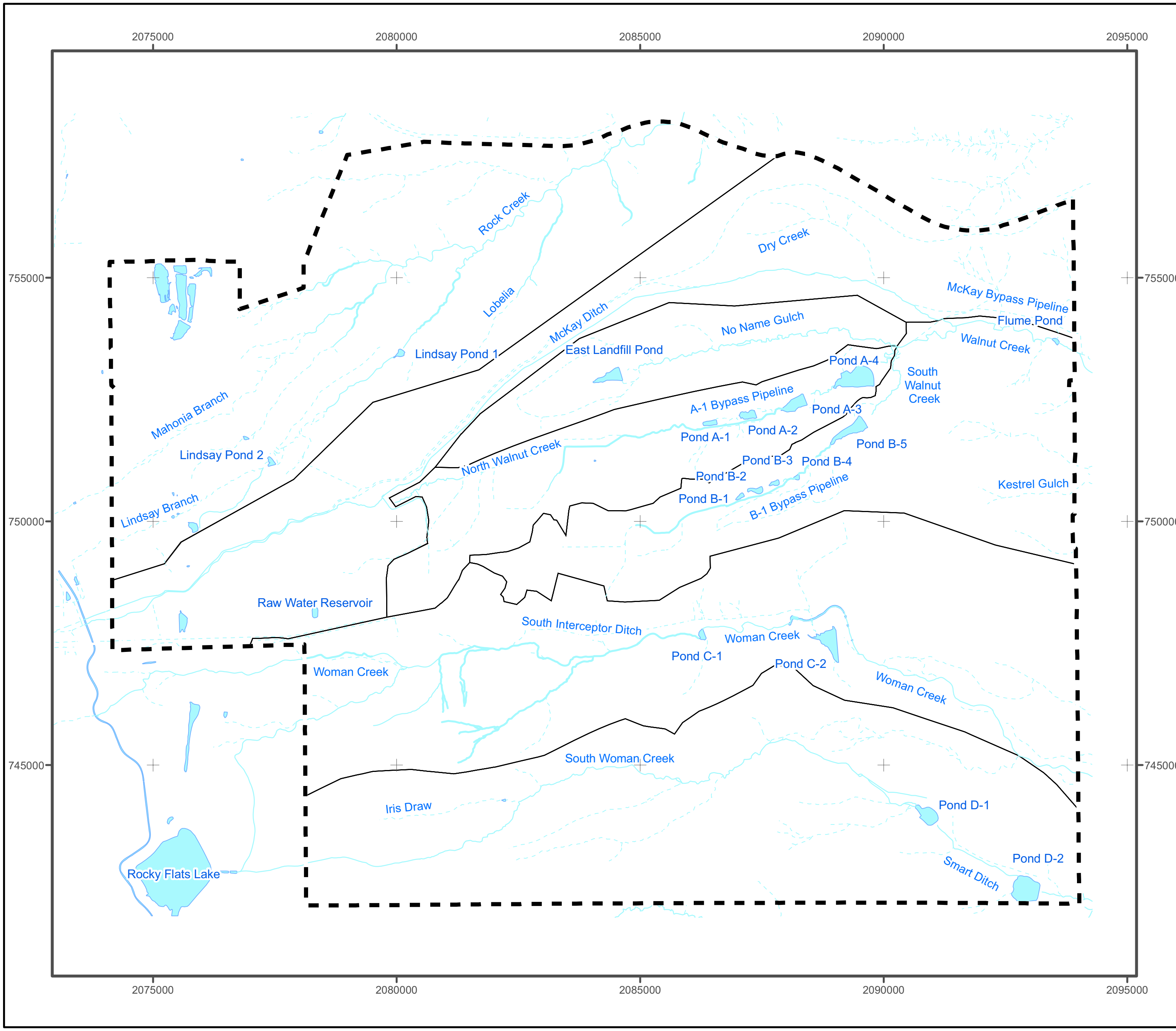

Figure 1.7
Surface Water Hydrology
of RFETS

KEY

Aquatic exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream

N
W E
S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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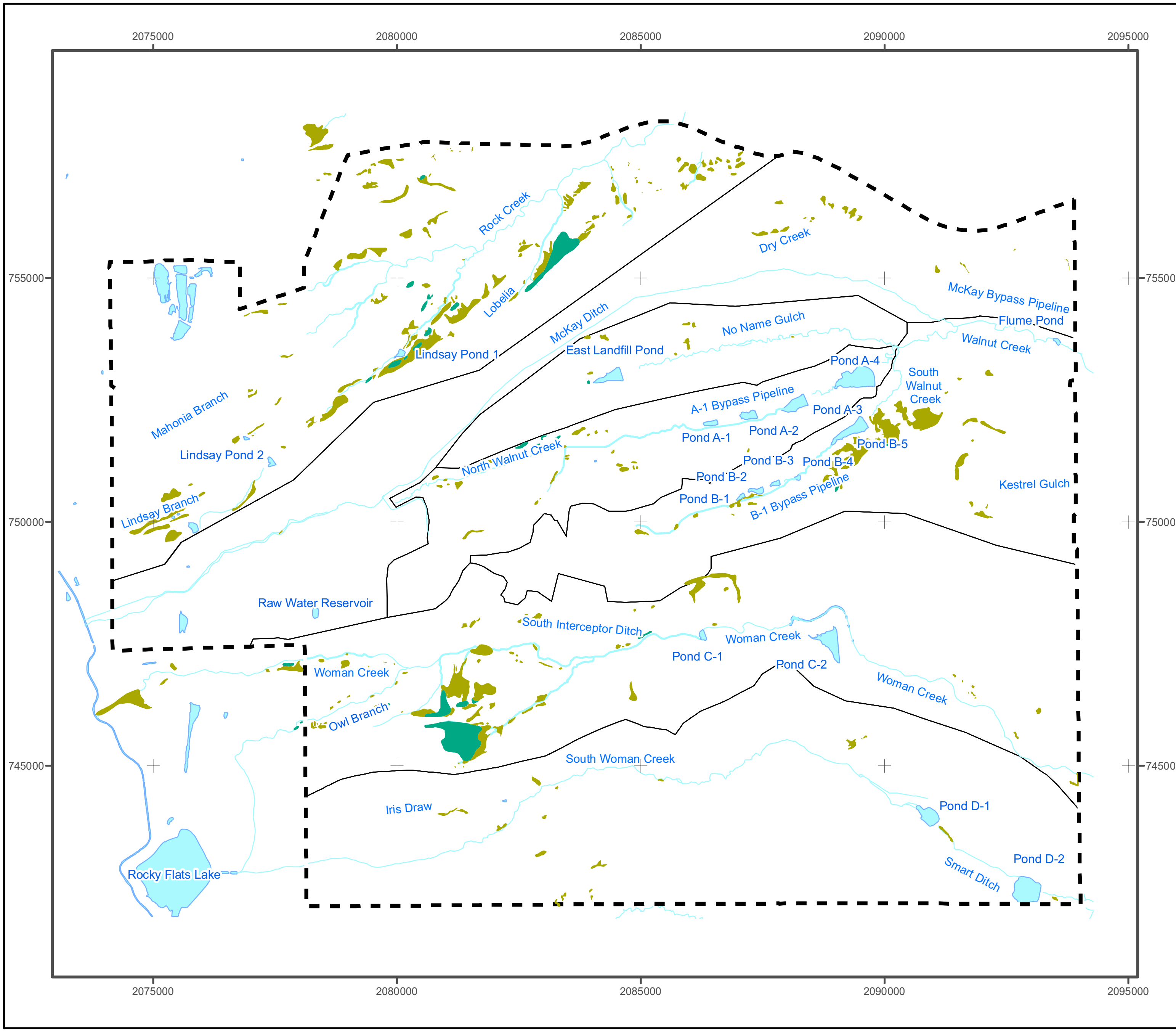

Figure 1.8

Intermittent and Perennial Stream Segments and Seep Locations at RFETS

KEY

- Ephemeral seep
- Perennial seep

Data Source:
Seep locations from EG&G 1995, Hydrogeologic Characterization Report for the Rocky Flats Environmental Technology Site

Standard Map Features

- Aquatic exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 1,250 2,500 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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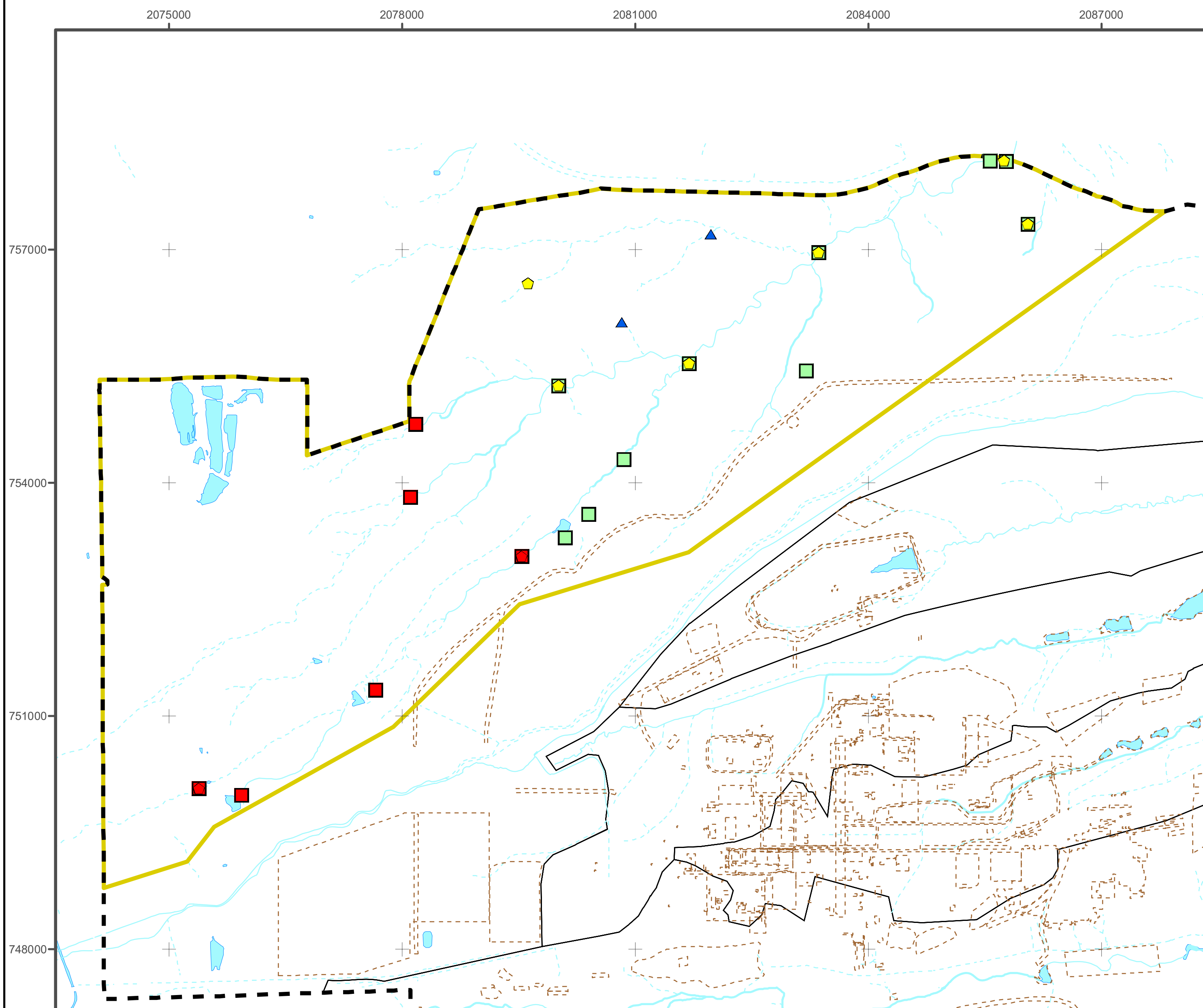
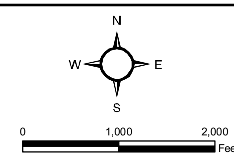
Figure 1.9
Rock Creek AEU Surface Water, Sediment and Adjacent Surface Soil Sampling Locations



KEY

Sample location
Surface water\sample location
Surface sediment\sample location
Surface soil sample location
(Background locations shown in red)
Surface sediment\sample location
Surface water sample location
Rock Creek AEU
Historical IHSS/PAC

Standard Map Features
Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream



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State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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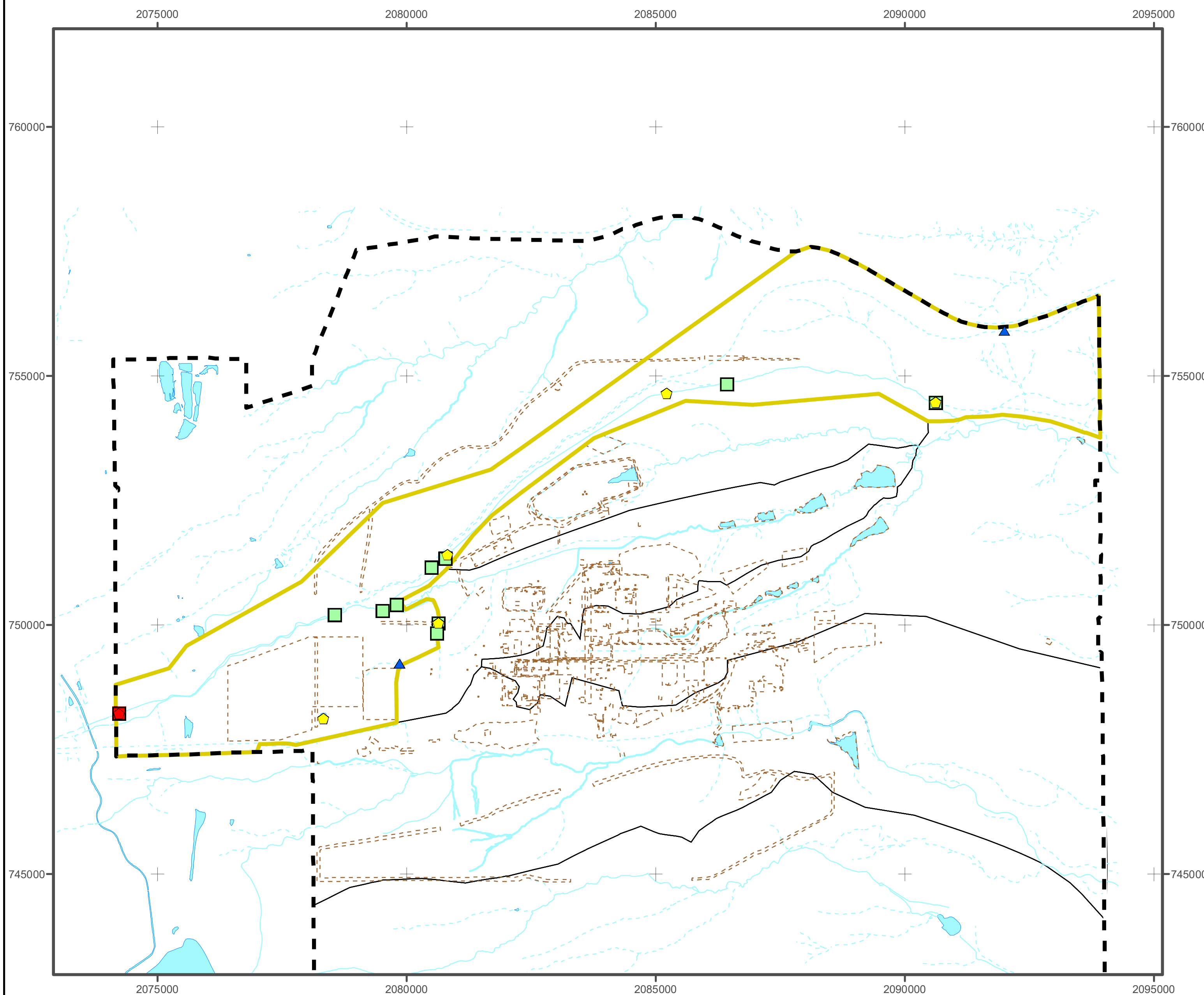

Figure 1.10
McKay Ditch AEU Surface Water, Sediment and Adjacent Surface Soil Sampling Locations

KEY

Sample location
Surface water\sample location
Surface sediment\sample location
Surface soil sample location
(Background locations shown in red)
Surface sediment\sample location
Surface water sample location
McKay Ditch AEU
Historical IHSS/PAC

Standard Map Features
Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream

N
W E
S

0 1,500 3,000
Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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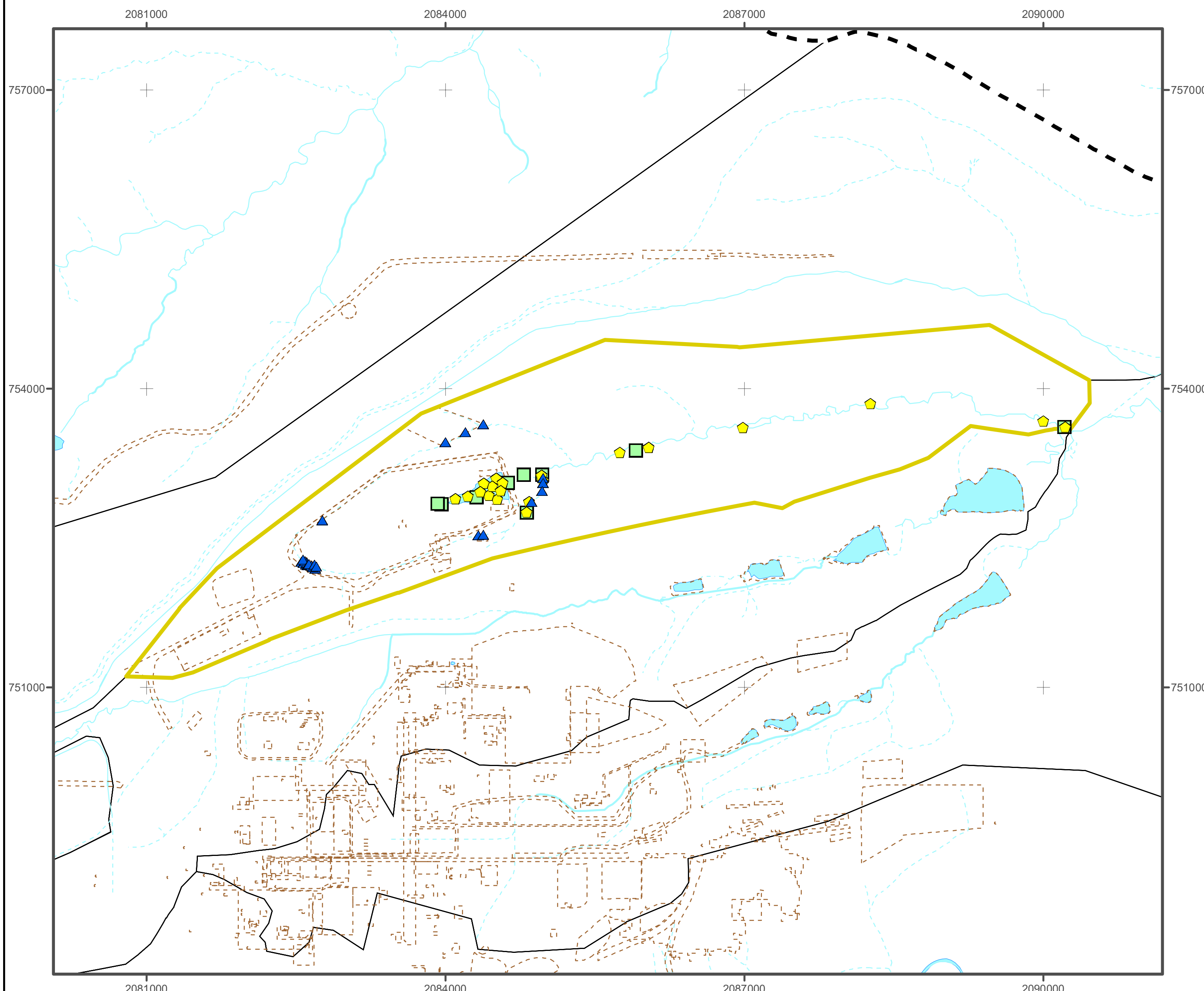
Figure 1.11
No Name Gulch AEU Surface
Water, Sediment and Adjacent
Surface Soil Sampling Locations



KEY

Sample location

- Surface water\sample location
- Surface sediment\sample location
- Surface soil sample location
- No Name Gulch AEU
- Historical IHSS/PAC

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 750 1,500 Feet

Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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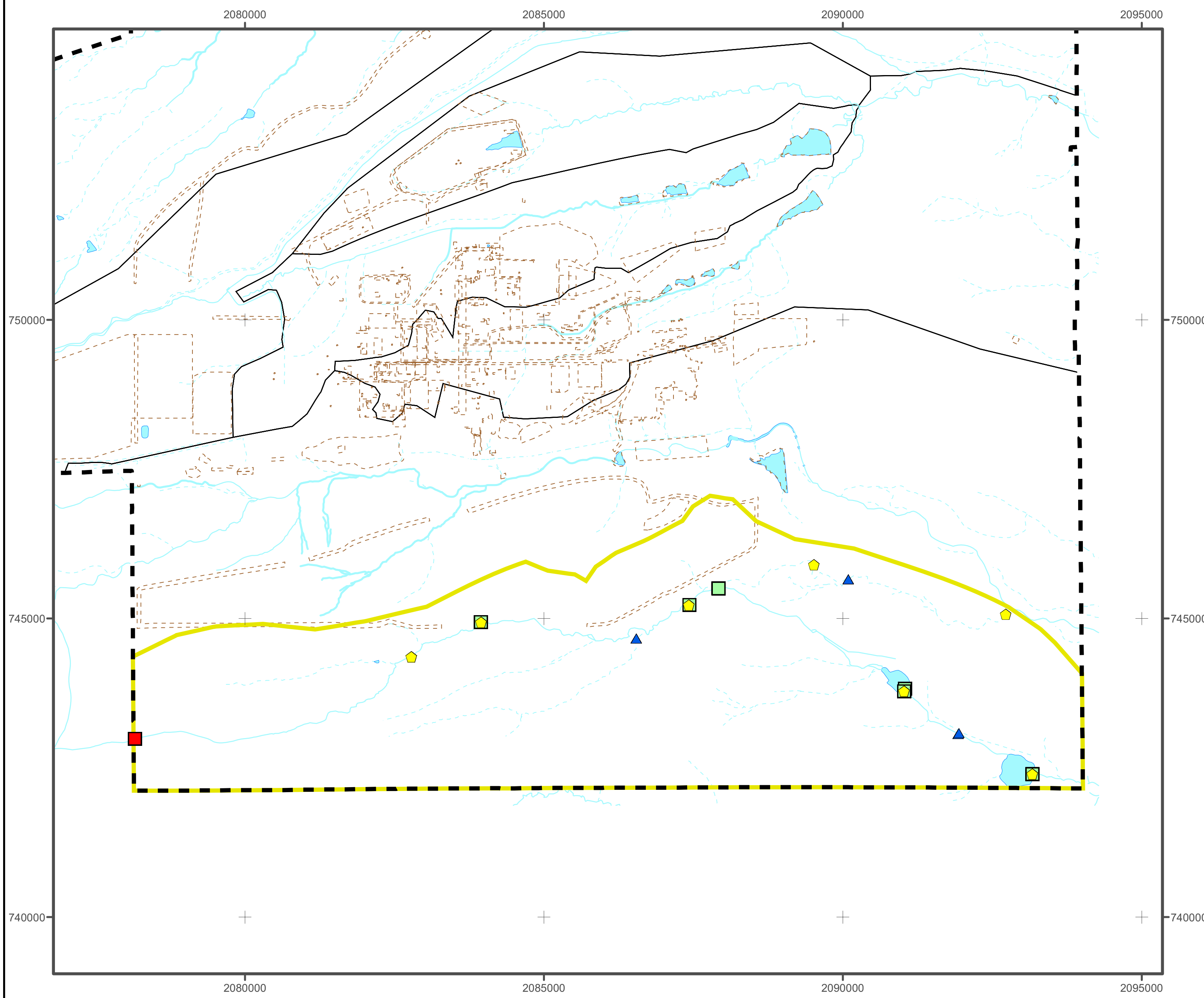

Figure 1.12
Southeast AEU Surface Water, Sediment and Adjacent Surface Soil Sampling Locations

KEY

Sample location

Surface water\sample location

Surface sediment\sample location

Surface soil sample location

(Background locations shown in red)

Surface water sample location

South Walnut Creek AEU

Historical IHSS/PAC

Standard Map Features

Exposure unit boundary

Pond

Site boundary

Perennial stream

Intermittent stream

Ephemeral stream

N
W E
S

0 1,250 2,500 Feet

Scale 1:30,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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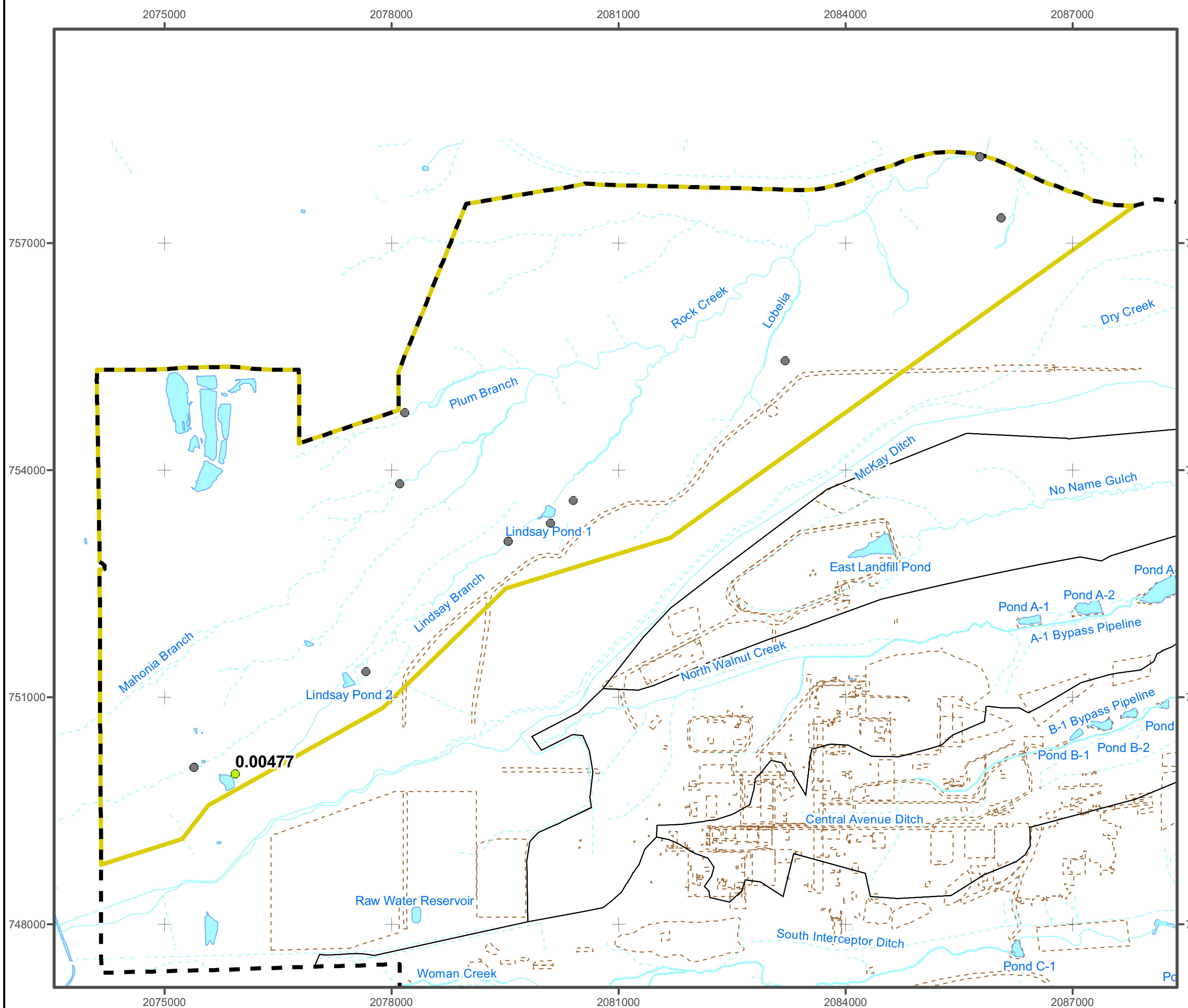

Figure 2.1
Rock Creek AEU
Surface Water Results for
Mercury (Dissolved)

KEY

Sample location
Detect
Nondetect
Rock Creek AEU
Historical IHSS/PAC

Units = mg/L

CRA Methodology ESL=0.00077 mg/L

Note:
Some reported results for nondetects exceed the ESLs. See Attachment 1

Standard Map Features
Aquatic exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream

N
W E
S
0 1,000 2,000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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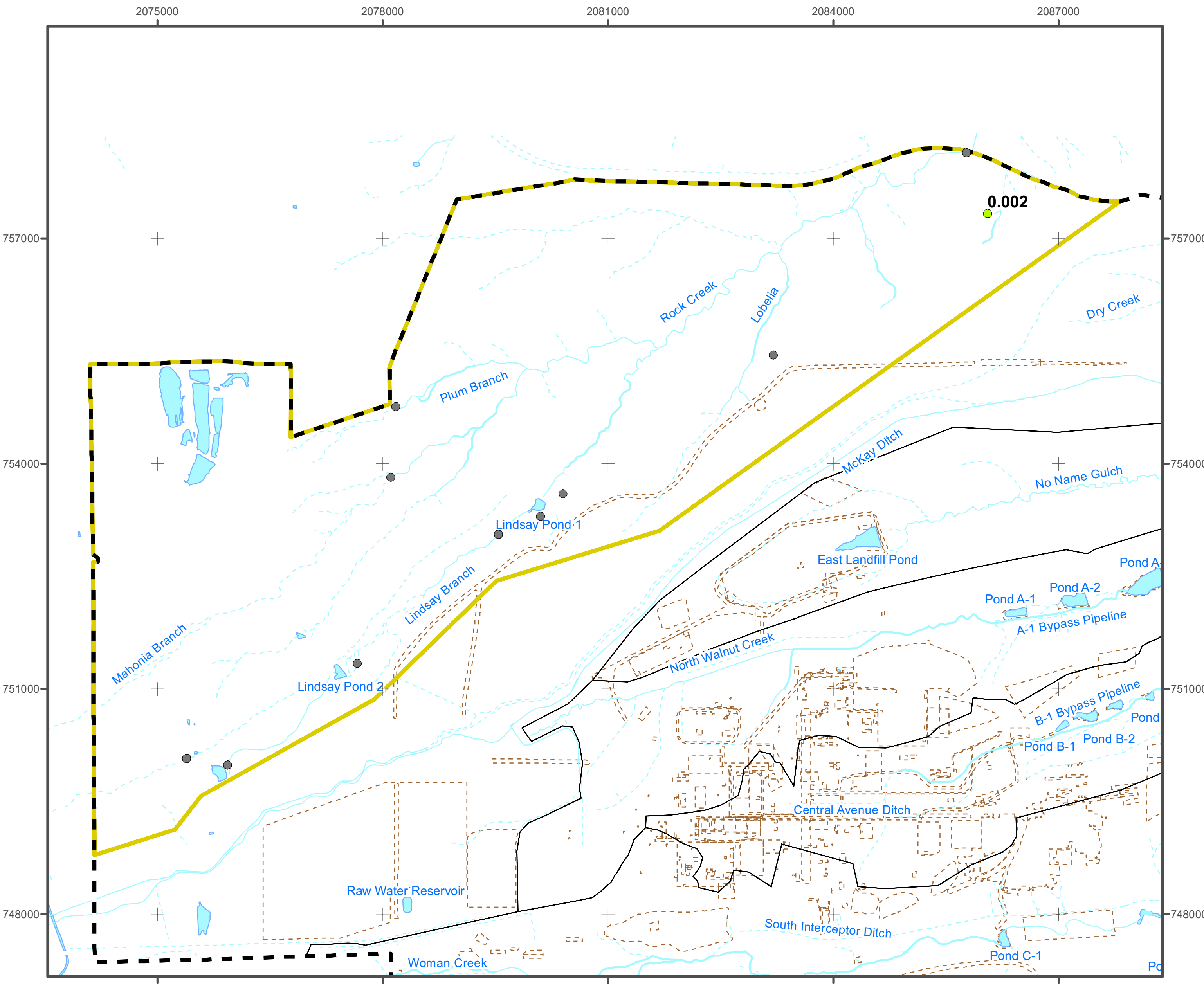

Figure 2.2
Rock Creek AEU
Surface Water Results for
Silver (Dissolved)

KEY

Sample location
Detect
Nondetect
Rock Creek AEU
Historical IHSS/PAC

Units = mg/L

CRA Methodology ESL=0.00032 mg/L

Note:
Some reported results for nondetects exceed the ESLs. See Attachment 1

Standard Map Features
Aquatic exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream

N W E S

0 1,000 2,000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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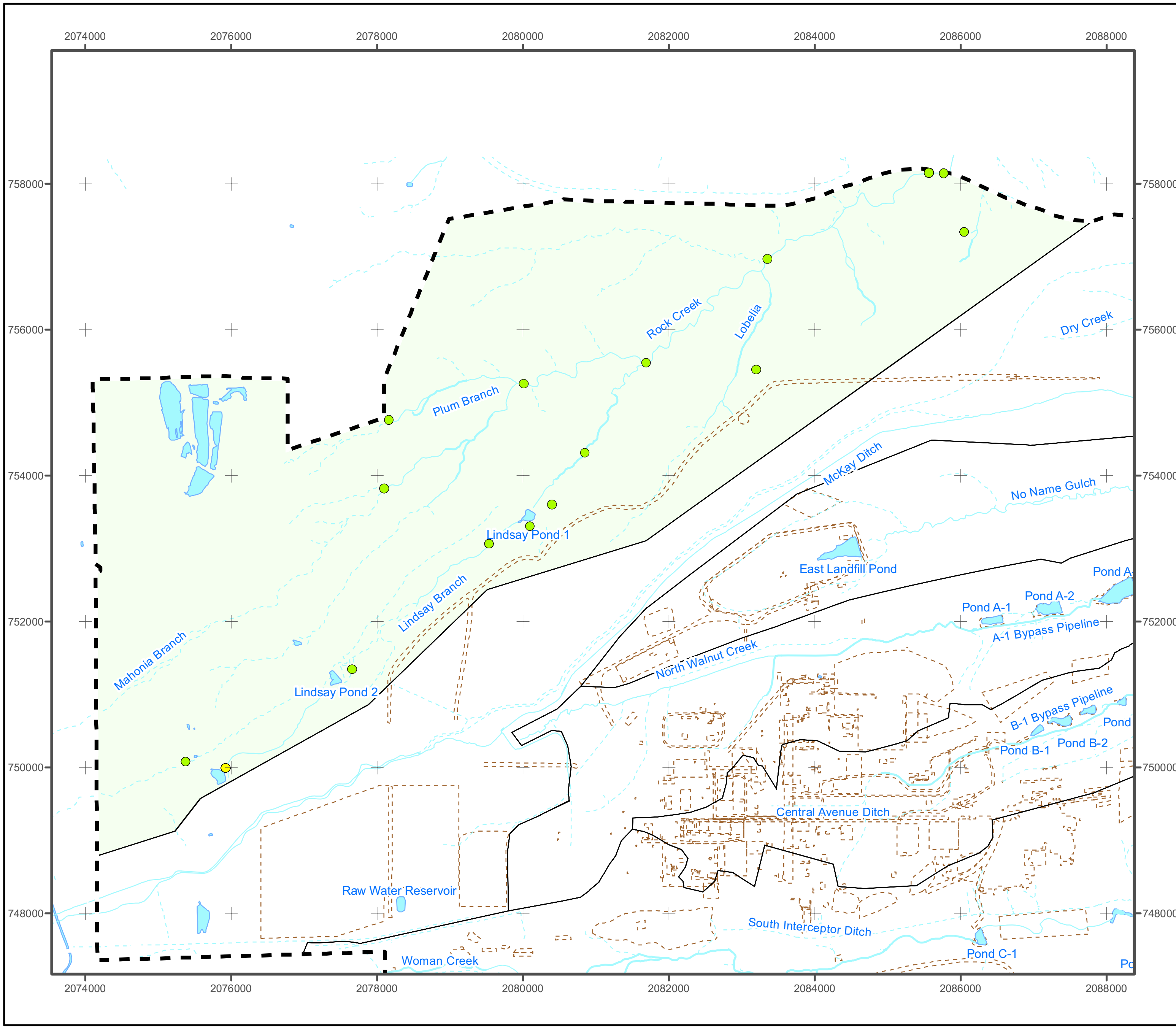

Figure 2.3
Rock Creek AEU
Surface Water Sampling Locations
for Barium (total)

KEY

Sampling location
>= ESL
< ESL
Nondetect

Chronic ESL = 0.438 mg/L

Standard Map Features
Rock Creek AEU
Aquatic Exposure Unit boundary
Historical IHSS/PAC
Pond
Perennial stream
Intermittent stream
Ephemeral stream
Site boundary

N
W E
S
0 1,000 2,000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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File: W:\Projects\FY2005\RIFS_Fig\CRA\
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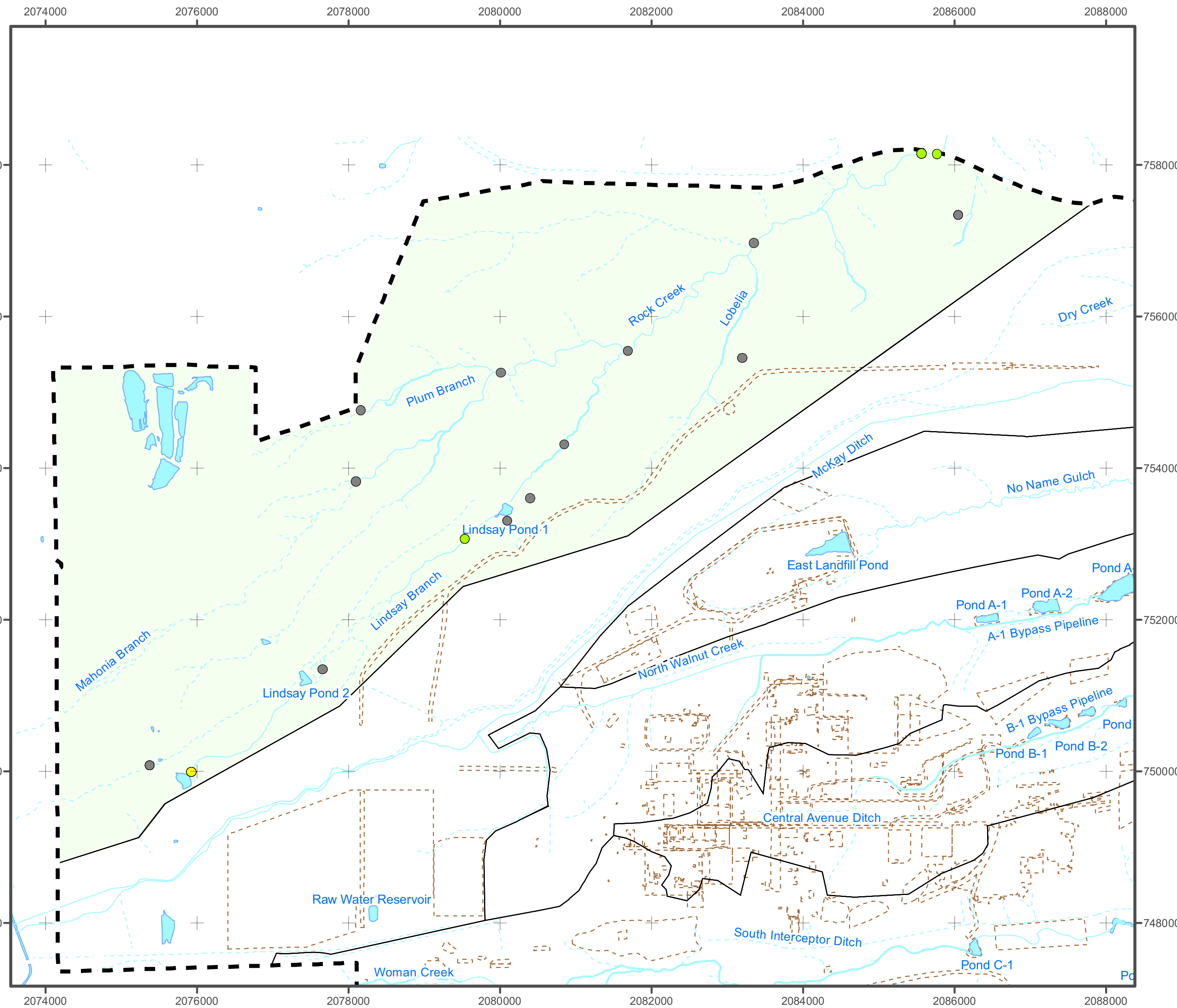

Figure 2.4
Rock Creek AEU
Surface Water Sampling Locations
for Beryllium (total)

KEY

Sampling location
>= ESL
< ESL
Nondetect

Chronic ESL = 0.0024 mg/L

Standard Map Features
Rock Creek AEU
Aquatic Exposure Unit boundary
Historical IHSS/PAC
Pond
Perennial stream
Intermittent stream
Ephemeral stream
Site boundary

N
W E
S
0 1,000 2,000
Feet
Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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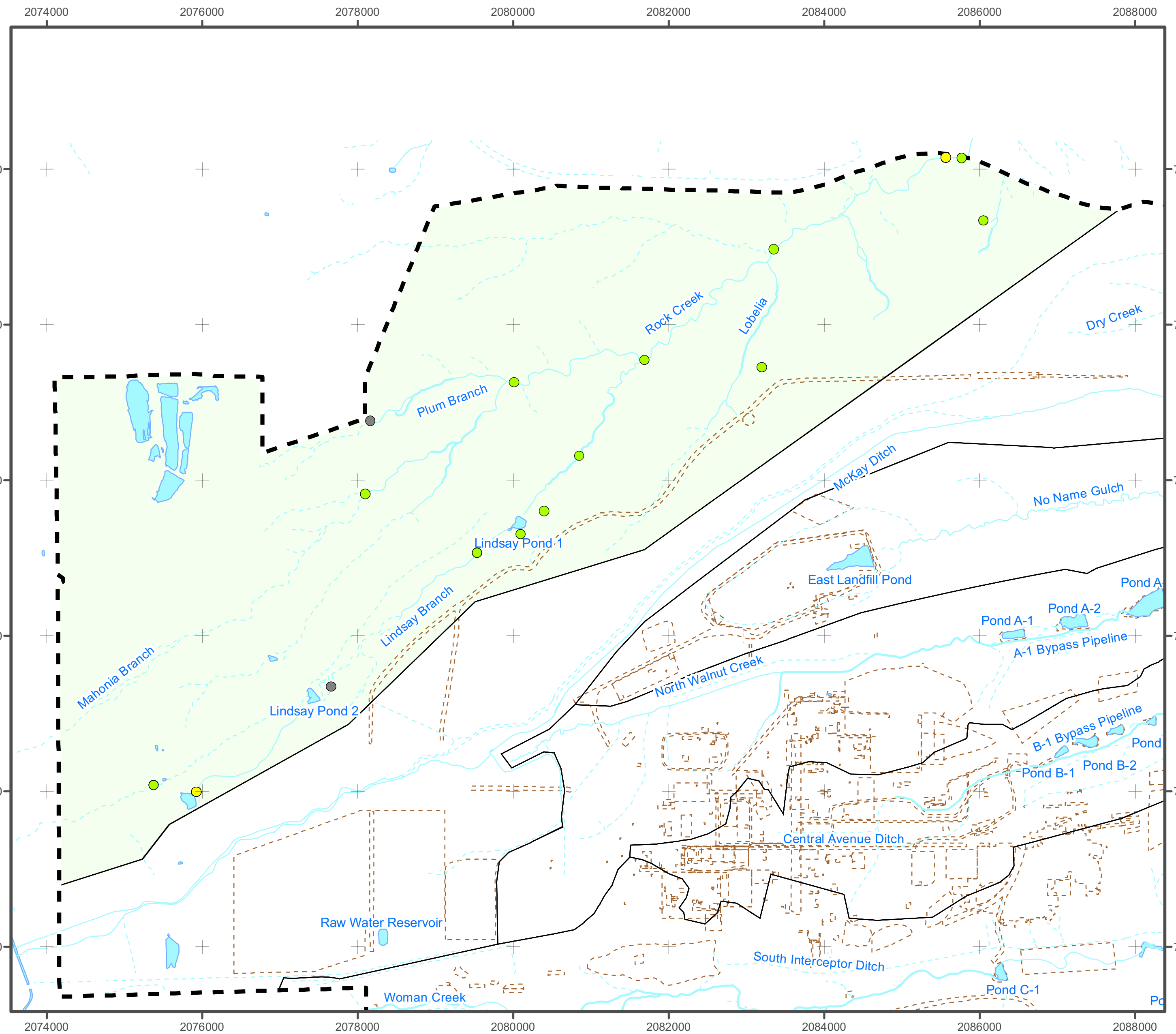

Figure 2.5
Rock Creek AEU
Surface Water Sampling Locations
for Lithium (total)

KEY

Sampling location
- >= ESL
- < ESL
- Nondetect

Chronic ESL = 0.096 mg/L

Standard Map Features
- Rock Creek AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 1,000 2,000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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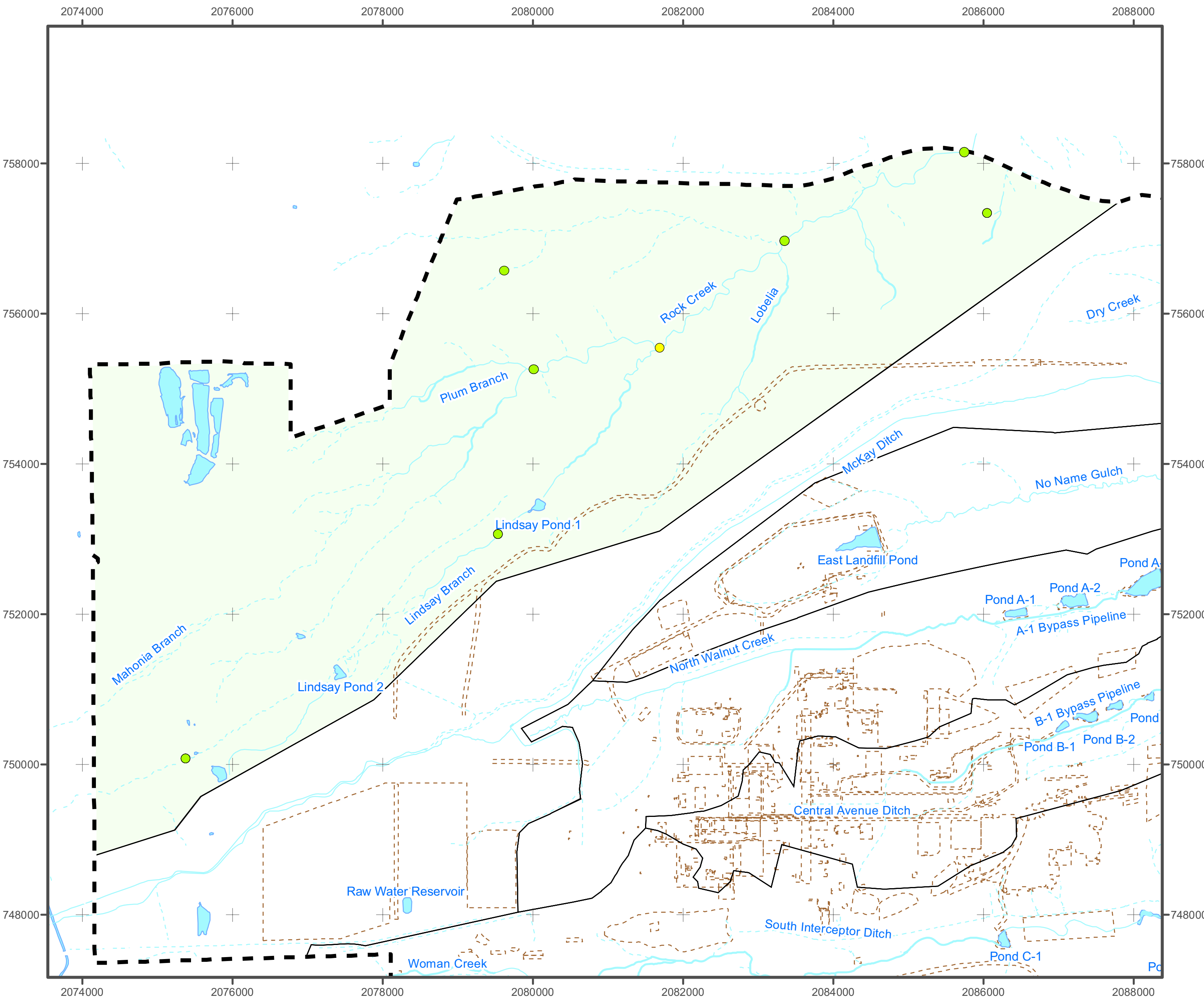
File: W:\Projects\FY2005\RIFS_Fig\CRA\Volume_15\Automated_sec2_AEU_Maps.mxd

Figure 2.6
Rock Creek AEU
Sediment Sampling Locations
for Nickel



KEY

Sampling location
- >= ESL
- < ESL
- Nondetect

NOEC ESL = 22.7 mg/kg

Standard Map Features
- Rock Creek AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 1,000 2,000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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File: W:\Projects\FY2005\RIFS_Fig\CRA\Volume_15\Automated_sec2_AEU_Maps.mxd

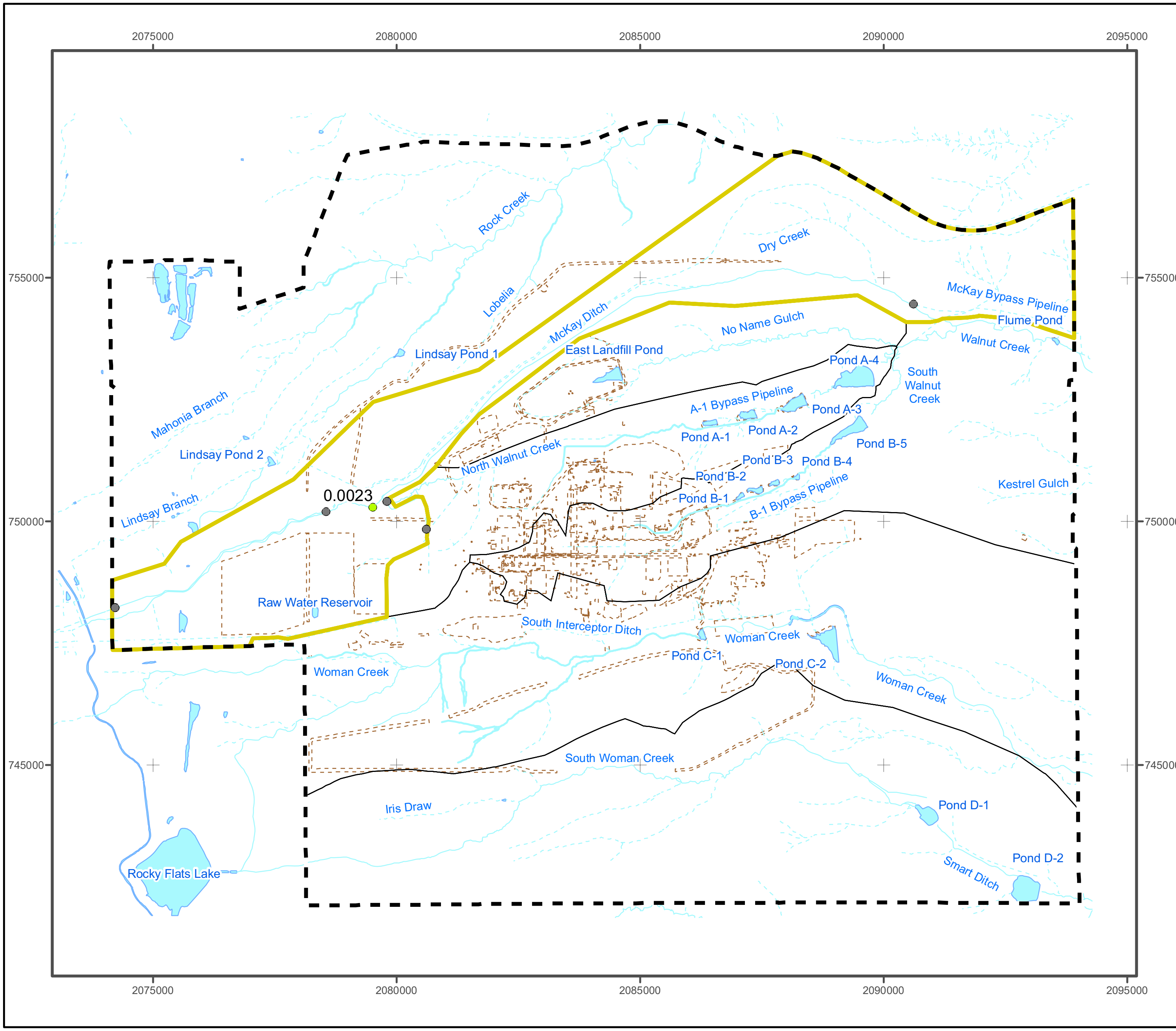

Figure 2.7
McKay Ditch AEU
Surface Water Results for Silver (Dissolved)

KEY

Sample location
- Detect
- Nondetect
- McKay Ditch AEU
- Historical IHSS/PAC

Units = mg/L

CRA Methodology ESL=0.00032 mg/L

Note:
Some reported results for nondetects exceed the ESLs. See Attachment 1

Standard Map Features
- Aquatic exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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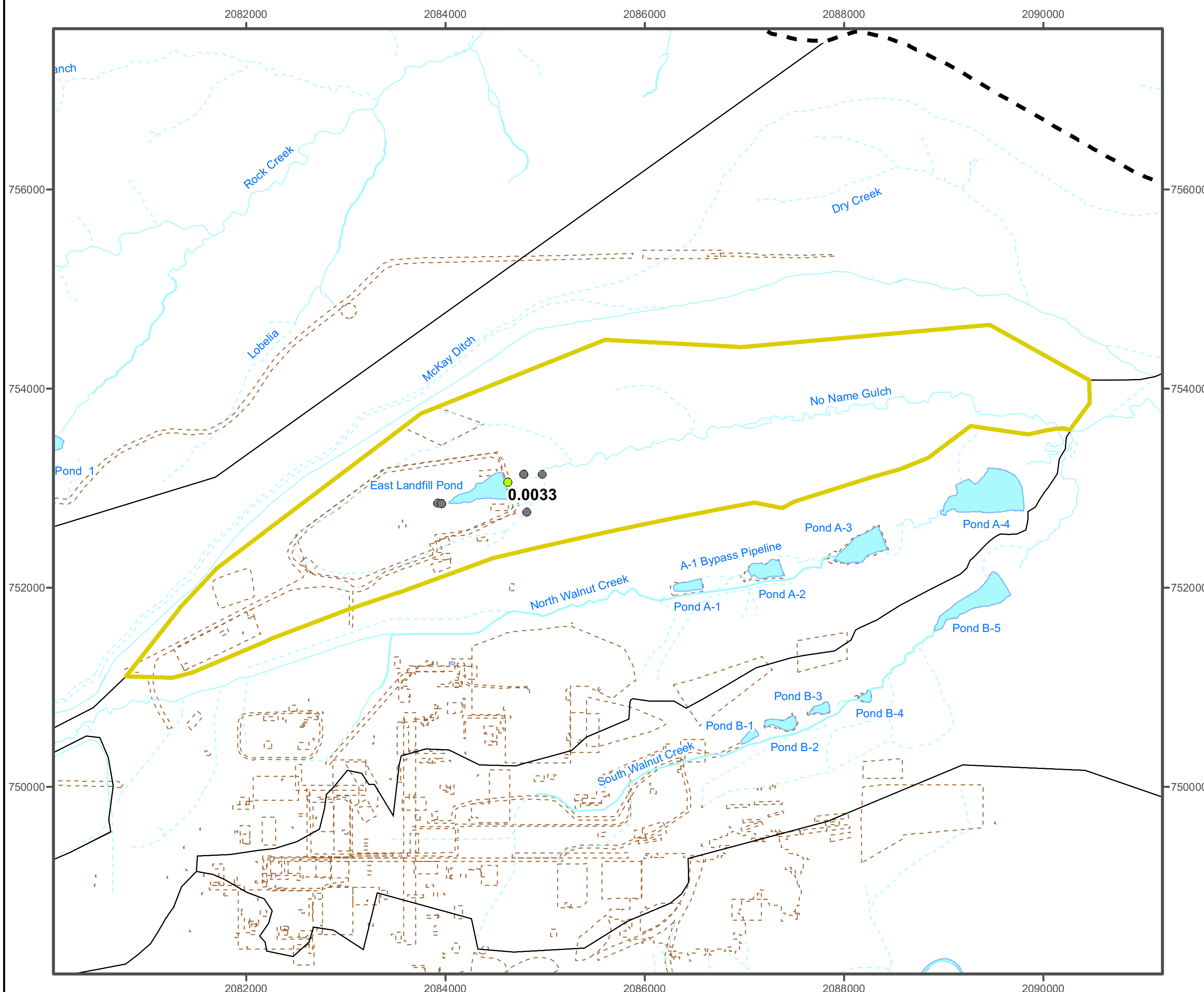

Figure 2.8
No Name Gulch AEU
Surface Water Results for
Cadmium (Dissolved)

KEY

Sample location
- Detect
- Nondetect
- No Name Gulch AEU
- Historical IHSS/PAC

Units = mg/L

CRA Methodology ESL = 0.00025 mg/L

Note:
Some reported results for nondetects exceed the ESLs. See Attachment 1

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 750 1,500 Feet

Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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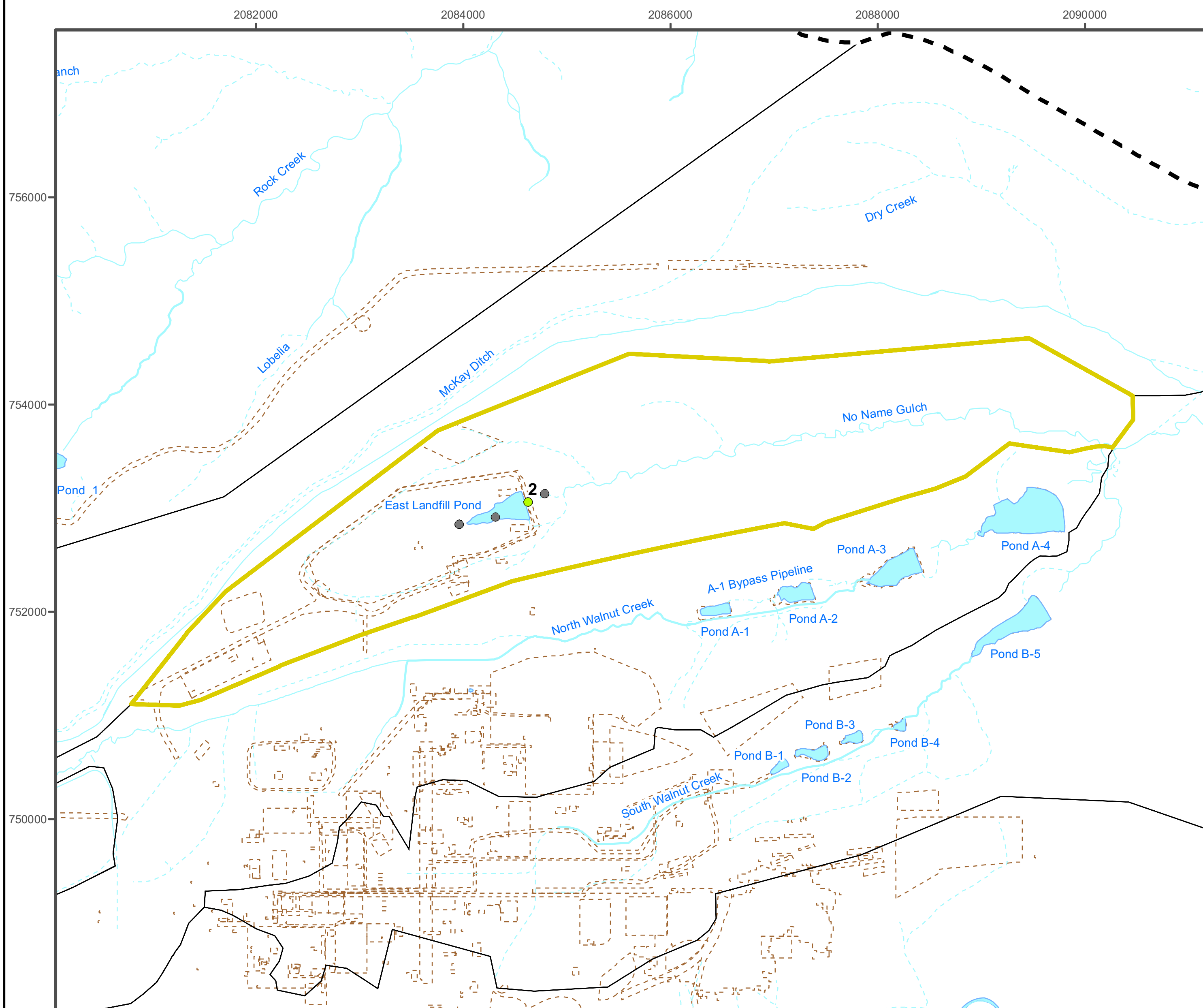

Figure 2.9
No Name Gulch AEU
Surface Water Results for
Pyrene

KEY

Sample location
- Detect
- Nondetect
- No Name Gulch AEU
- Historical IHSS/PAC

Units = ug/L

CRA Methodology ESL = 0.025 ug/L

Note:
Some reported results for nondetects exceed the ESLs. See Attachment 1

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 750 1,500 Feet

Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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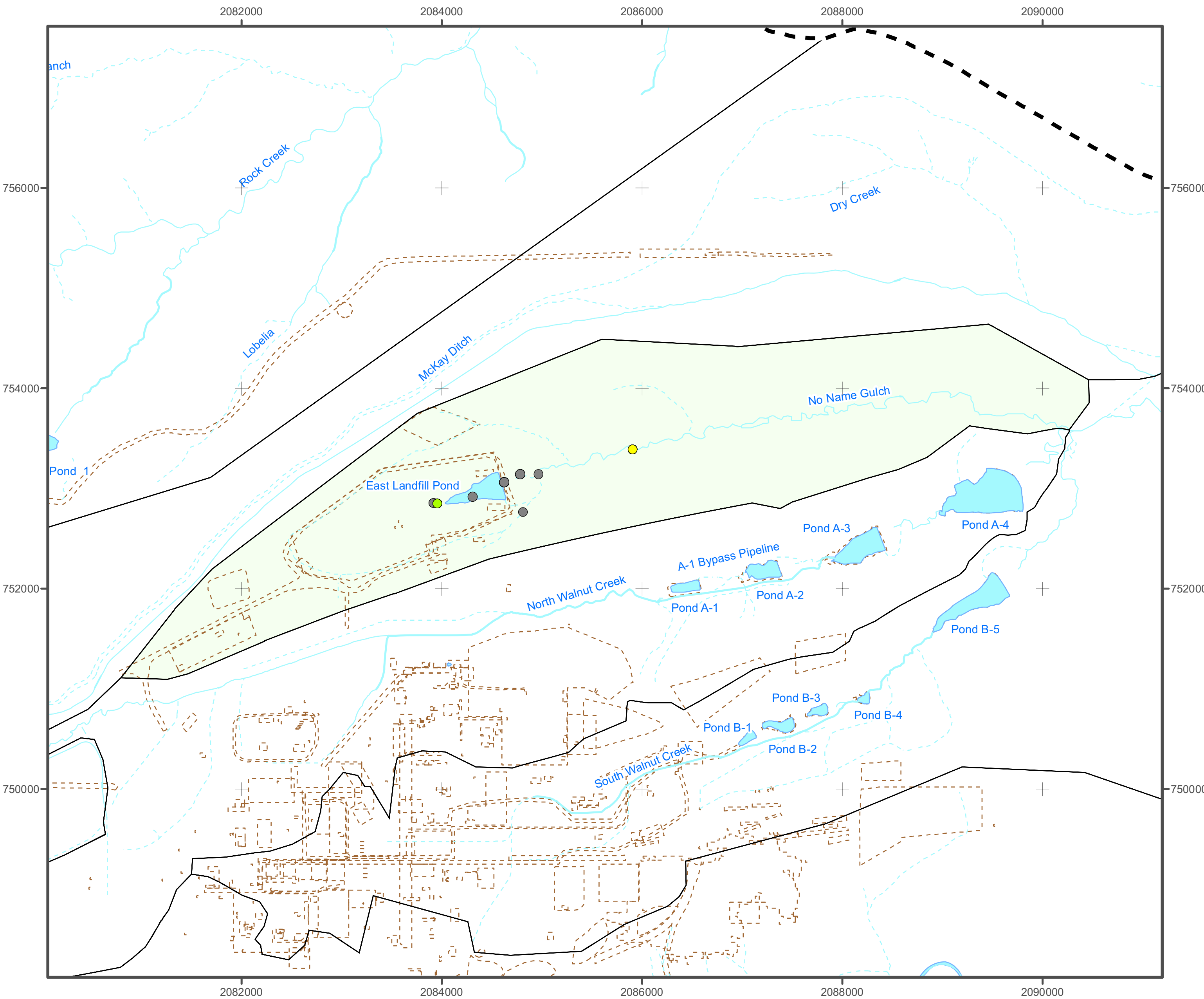

Figure 2.10
No Name Gulch AEU
Surface Water Sampling Locations
for Beryllium (total)

KEY

Sampling location
- >= ESL
- < ESL
- Nondetect

Chronic ESL = 0.0024 mg/L

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W
E
S

0 750 1,500 Feet

Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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File: W:\Projects\FY2005\RIFS_Fig\CRA\Volume_15\Automated_sec2_AEU_Maps.mxd

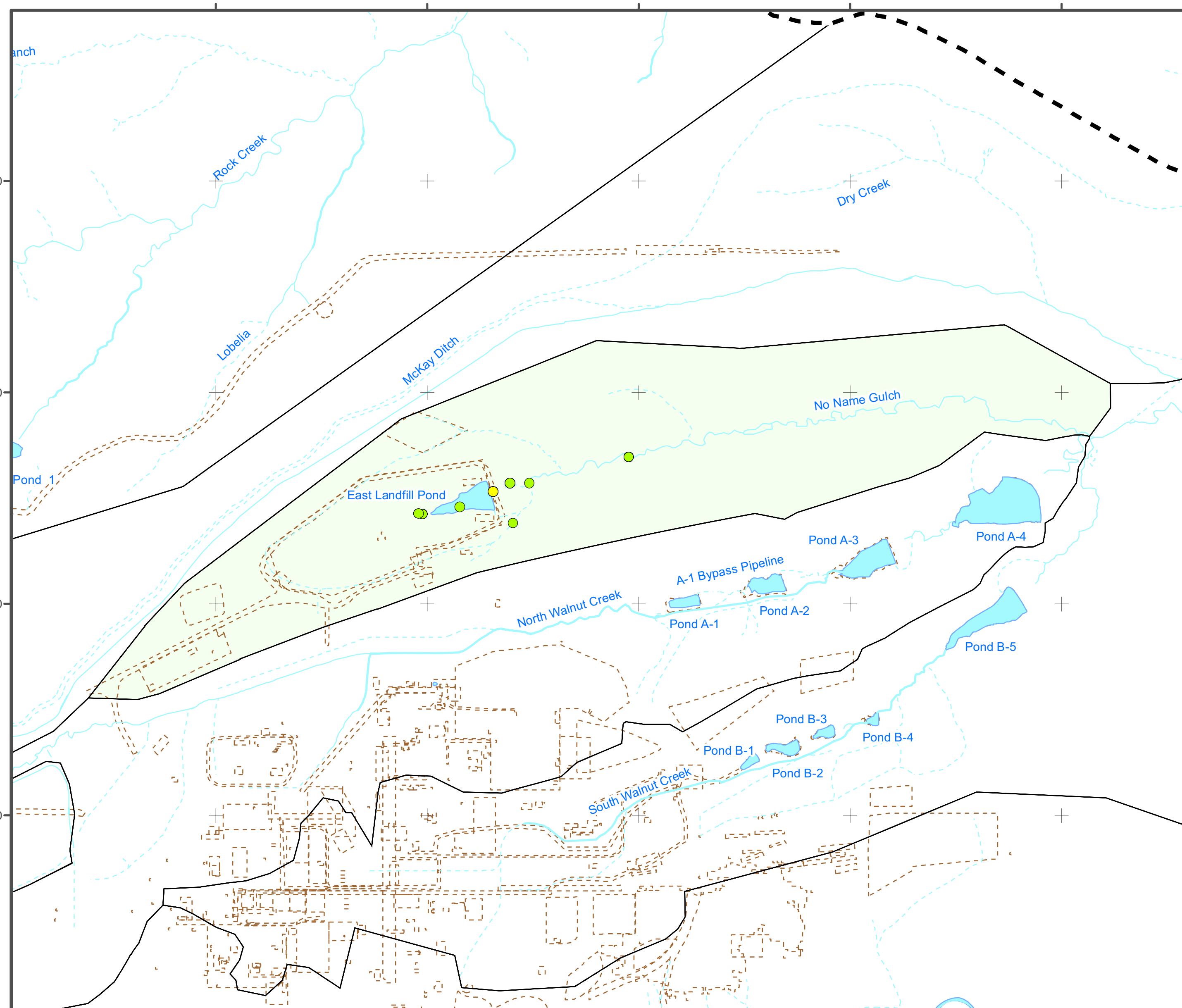

Figure 2.11
No Name Gulch AEU
Surface Water Sampling Locations
for Lithium (total)

KEY

Sampling location
>= ESL
< ESL
Nondetect

Chronic ESL = 0.096 mg/L

Standard Map Features
No Name Gulch AEU
Aquatic Exposure Unit boundary
Historical IHSS/PAC
Pond
Perennial stream
Intermittent stream
Ephemeral stream
Site boundary

N
W E
S

0 750 1,500 Feet

Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Figure 5.1
Temporal Trends in Surface Water Aluminum (Total) Concentrations
McKay Ditch AEU

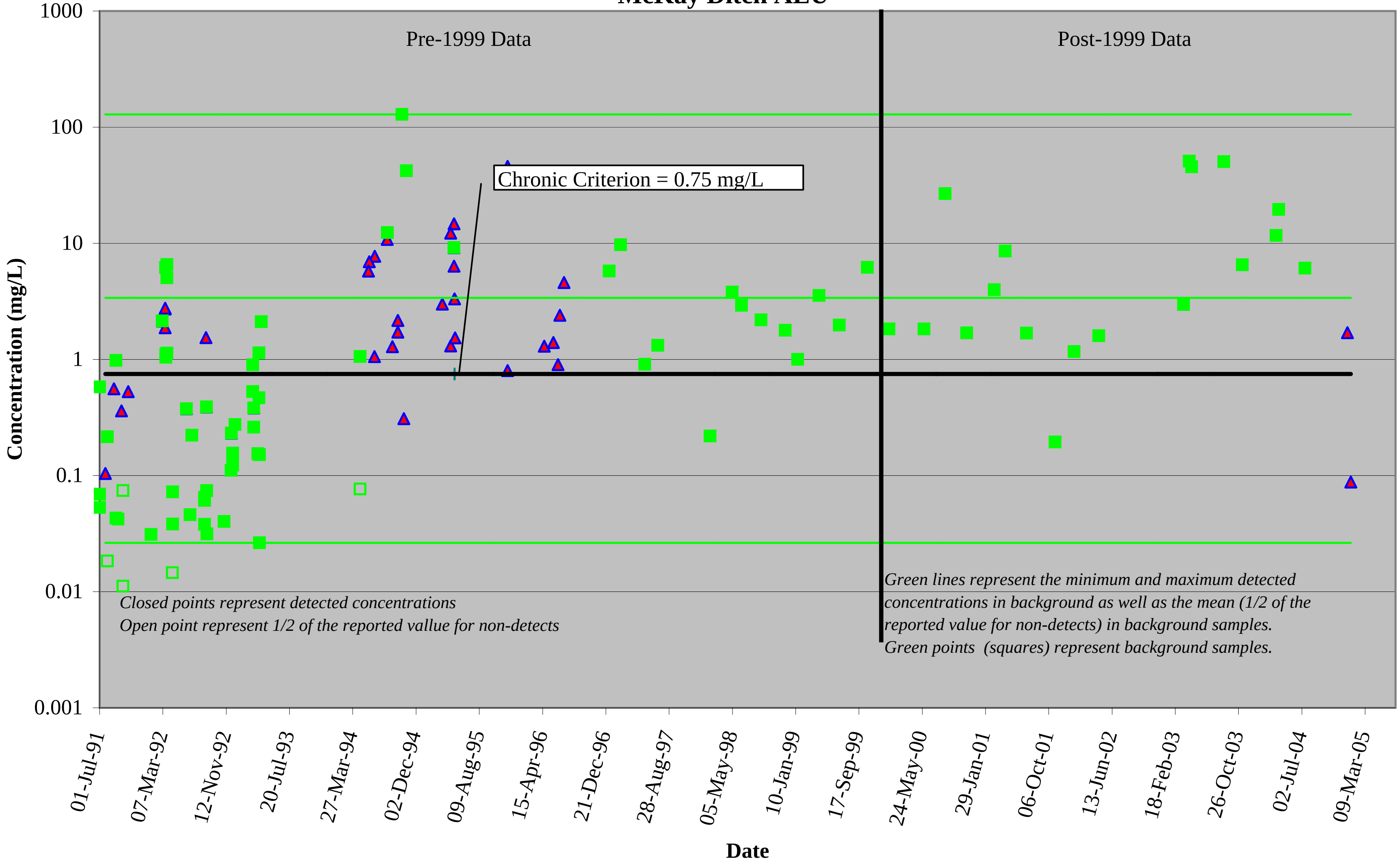
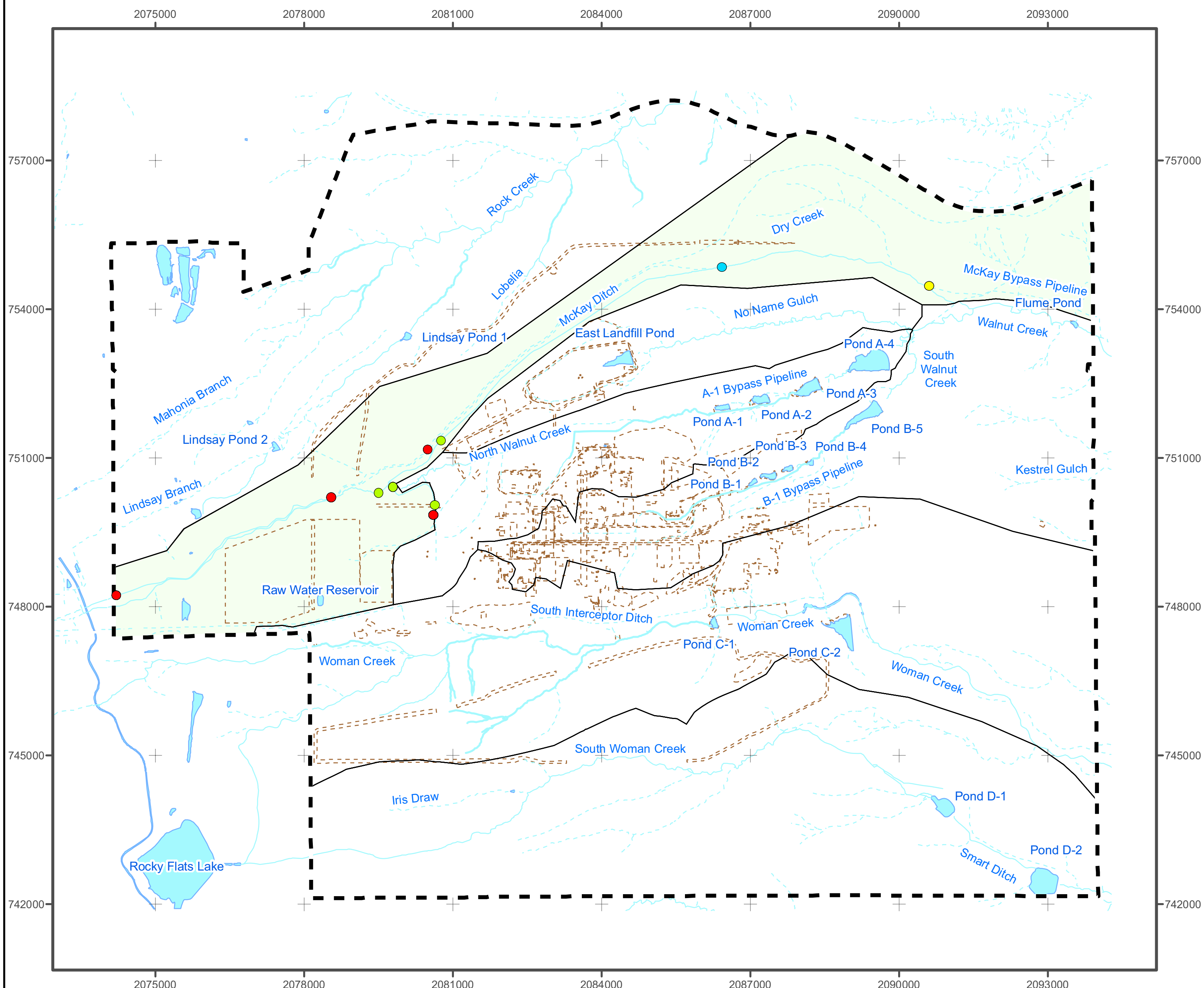


Figure 5.2
McKay Ditch AEU
Aluminum (total) HQs
Surface Water - Chronic ESL



KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on Chronic ESL
(0.75 mg/L)

Standard Map Features
- McKay Ditch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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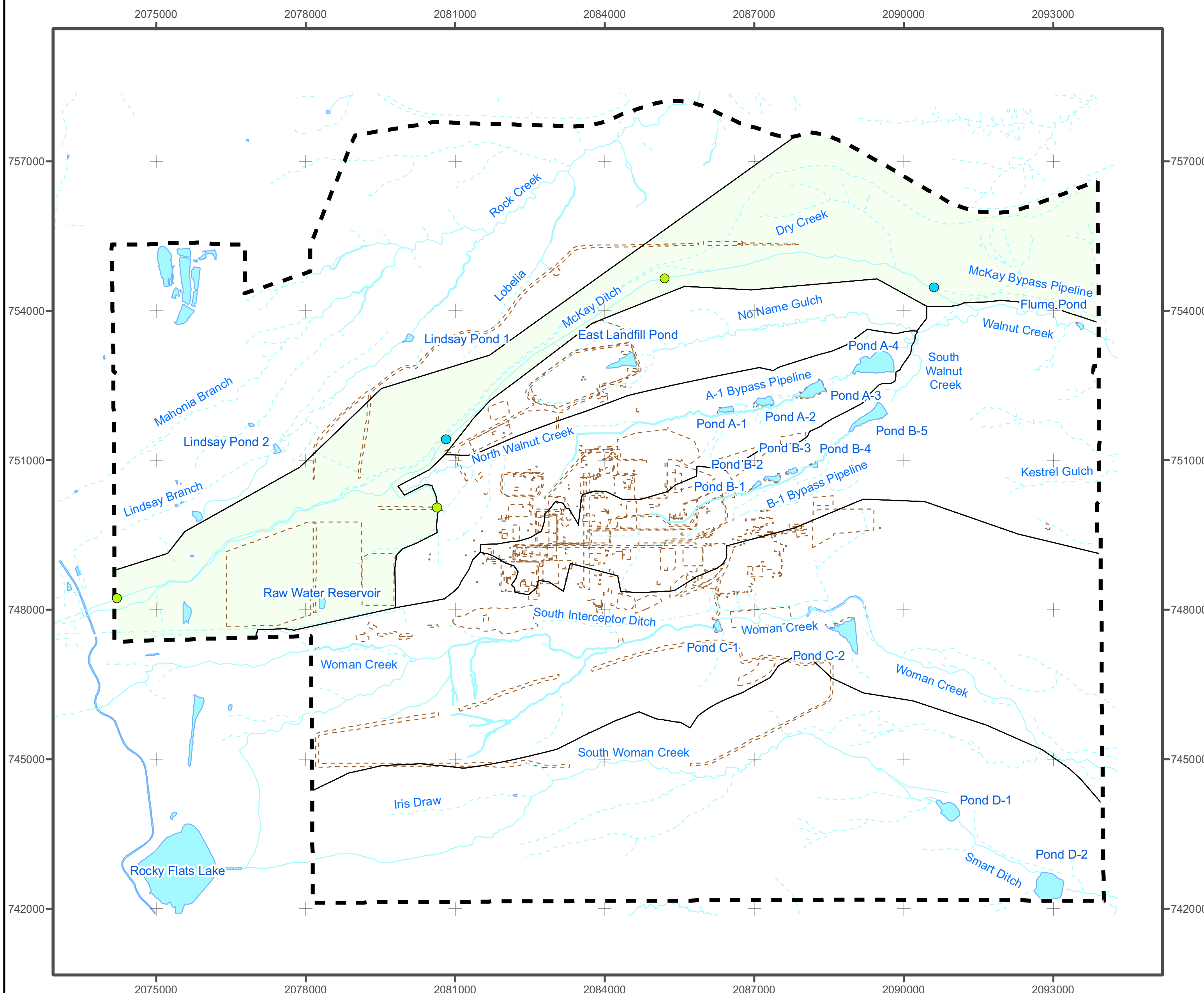
File: W:\Projects\FY2005\RIFS_Fig\CRA\Volume_15\Automated_sec5_AEU_Maps.mxd

Figure 5.3
McKay Ditch AEU
Aluminum HQs
Sediment - NOEC ESL



KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on NOEC ESL
(15900 mg/kg)

Note:
No LOEC HQs >1, so no LOEC figure provided.

Standard Map Features

- McKay Ditch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W
E
S

0 1,500 3,000
Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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File: W:\Projects\FY2005\RIFS_Fig\CRA\Volume_15\Automated_sec5_AEU_Maps.mxd

Figure 5.4
Temporal Trends in Surface Water Cadmium (Dissolved) Concentrations
McKay Ditch AEU

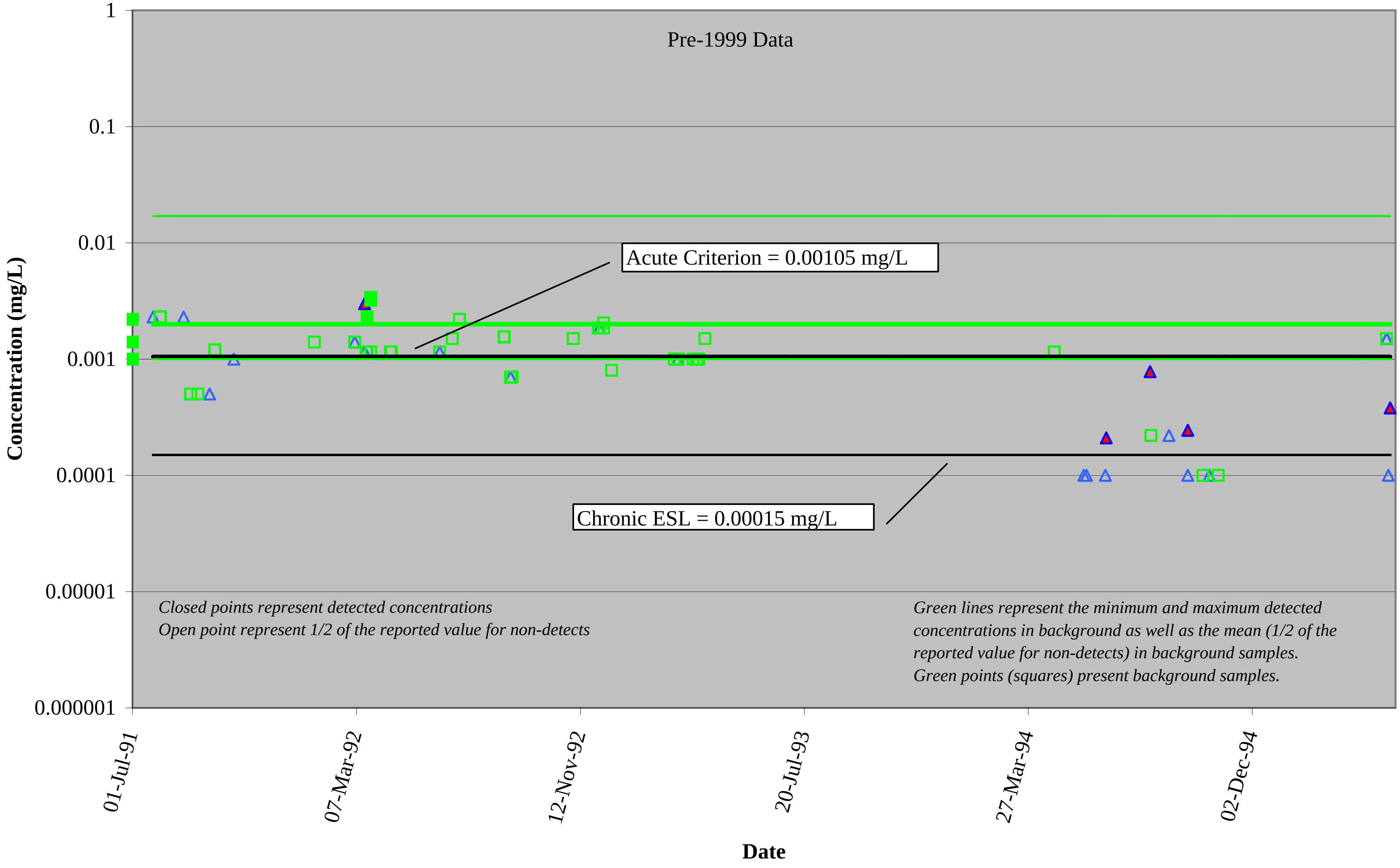
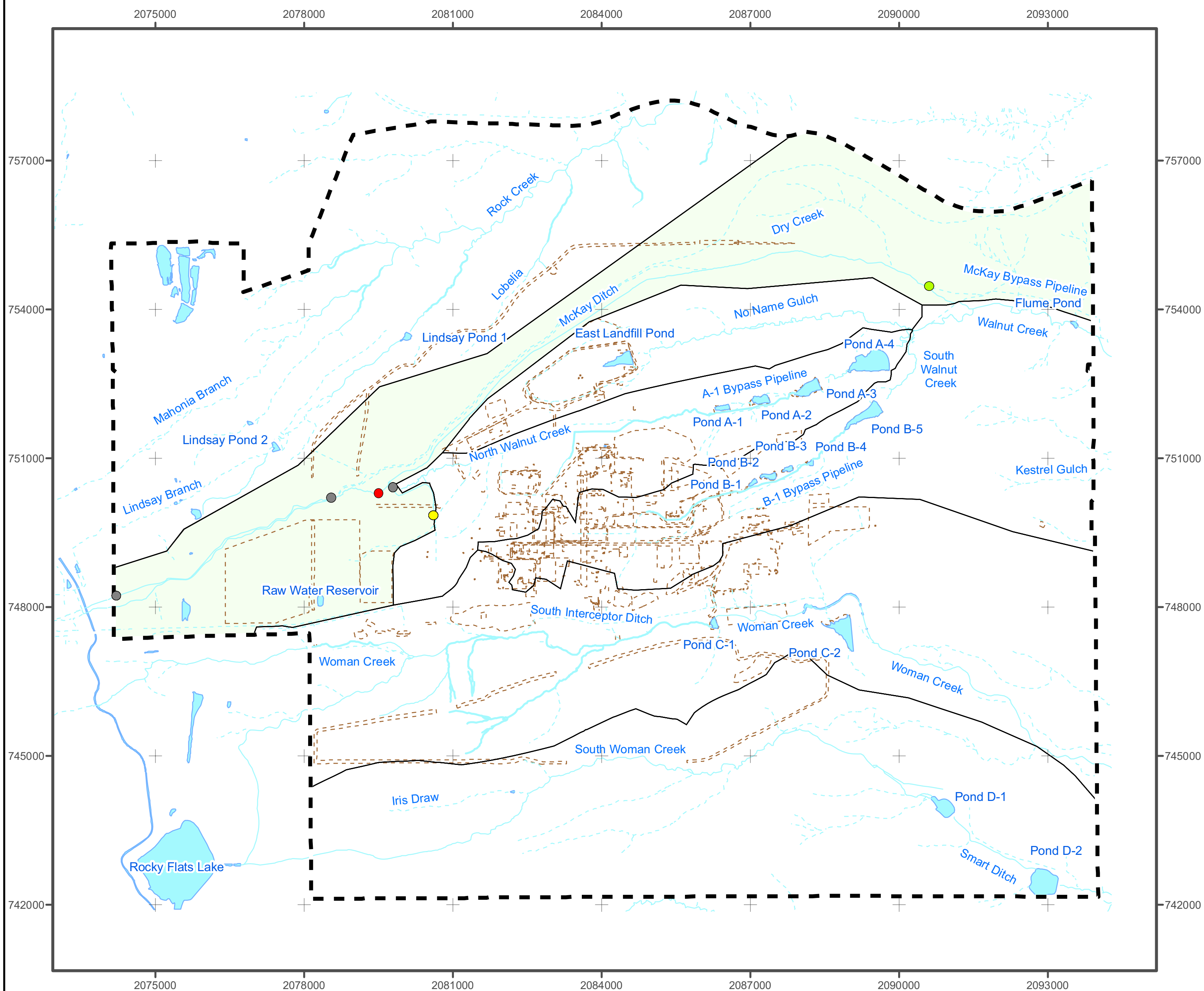


Figure 5.5
McKay Ditch AEU
Cadmium (dissolved) HQs
Surface Water - Chronic ESL



KEY

Sample location

- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on Chronic ESL
(0.000155 mg/L)

Note:
Some nondetect results exceed the Chronic ESL. See Table 5.2.

Standard Map Features

- McKay Ditch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 1,500 3,000
Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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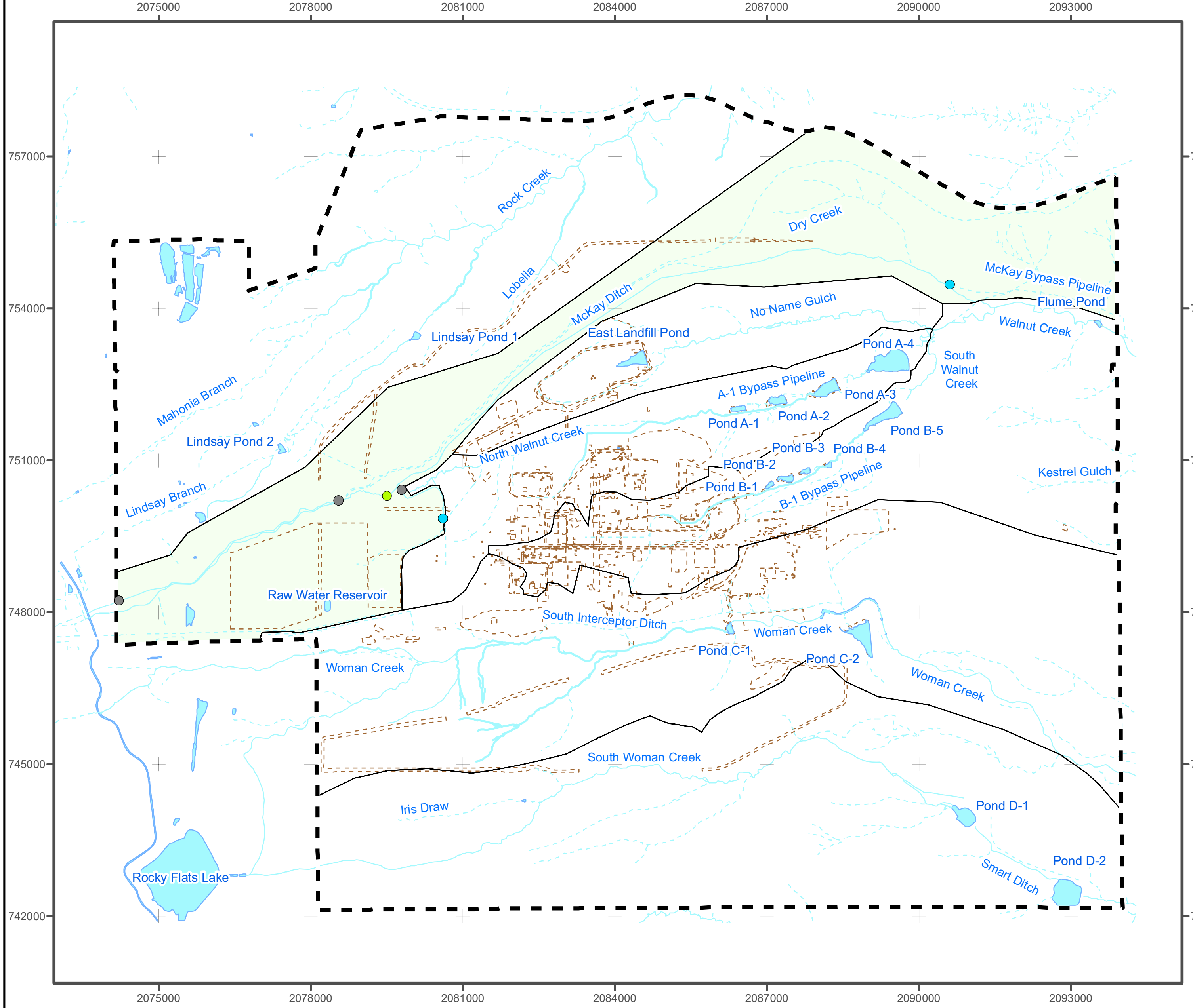

Figure 5.6
McKay Ditch AEU
Cadmium (dissolved) HQs
Surface Water - Acute Criterion

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on Acute AWQC
(0.00105 mg/L)

Note:
Some nondetect results exceed the Acute Criterion. See Table 5.2.

Standard Map Features
- McKay Ditch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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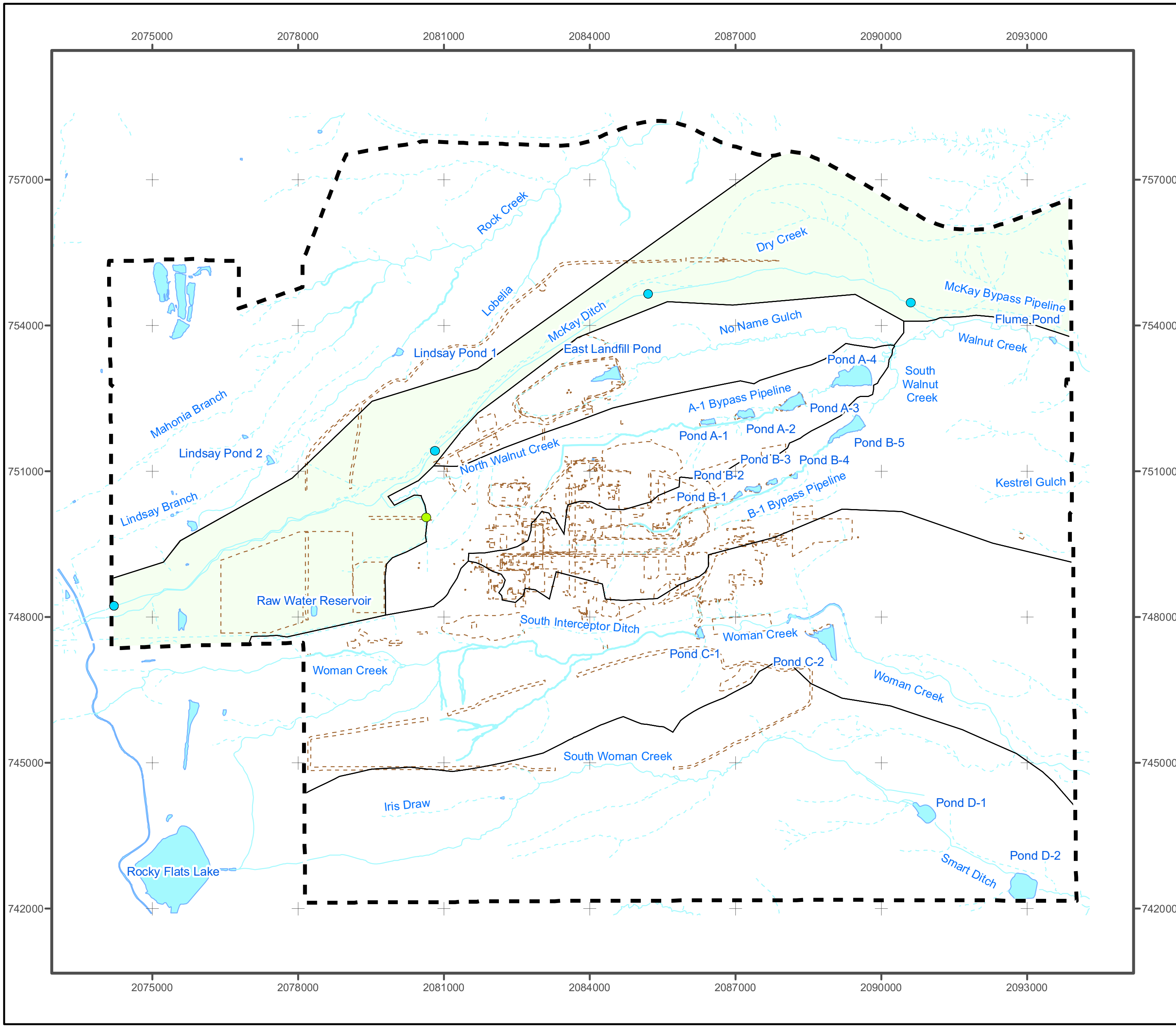
File: W:\Projects\FY2005\RIFS_Fig\CRA\Volume_15\Automated_sec5_AEU_Maps.mxd

Figure 5.7
McKay Ditch AEU
Chromium HQs
Sediment - NOEC ESL



KEY

Sample location

- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on NOEC ESL
(43.4 mg/kg)

Note:
No LOEC HQs >1, so no LOEC figure provided.

Standard Map Features

- McKay Ditch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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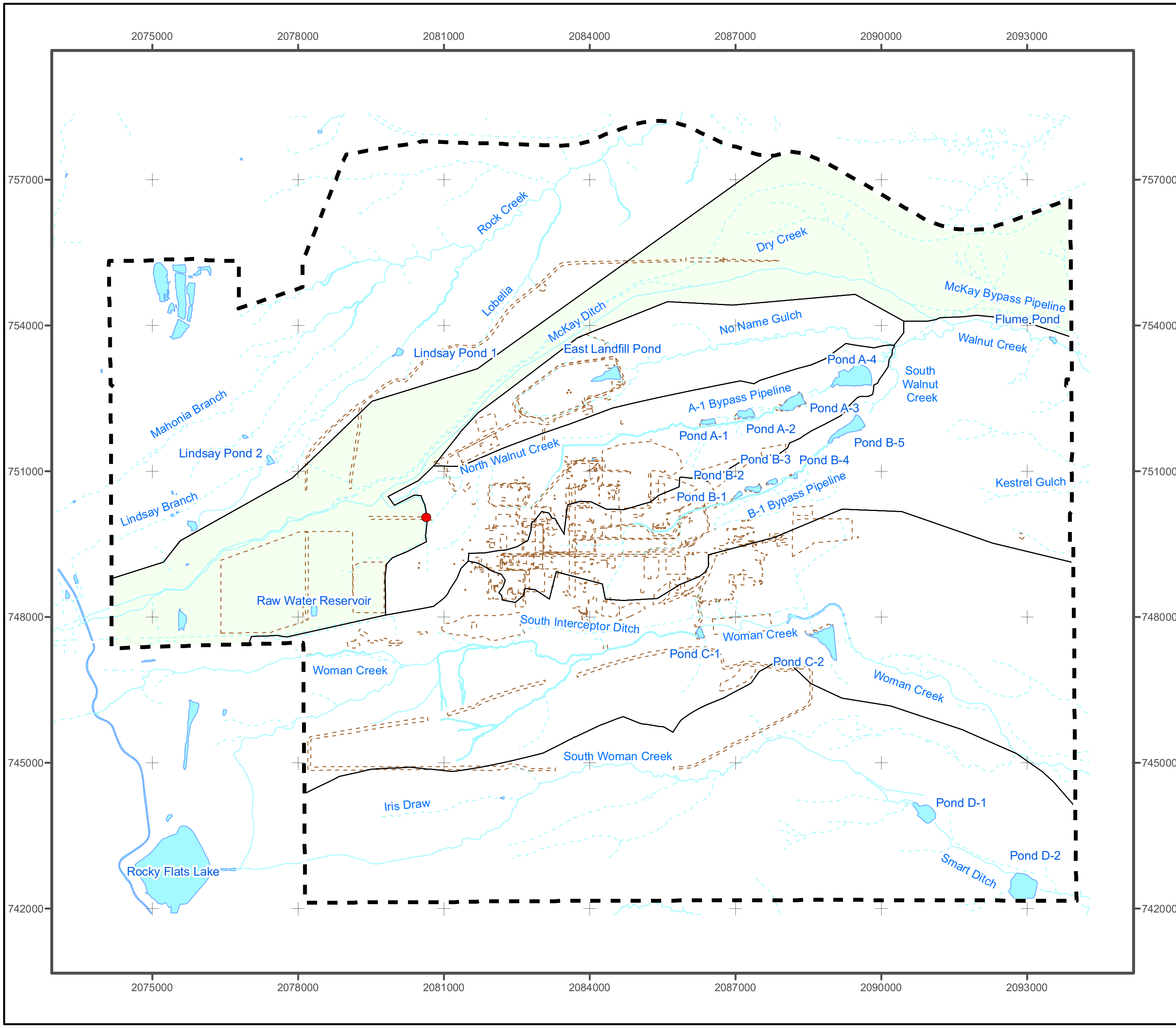

Figure 5.8
McKay Ditch AEU
Fluoride HQs
Sediment - NOEC ESL

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on NOEC ESL
(0.01 mg/kg)

Standard Map Features
- McKay Ditch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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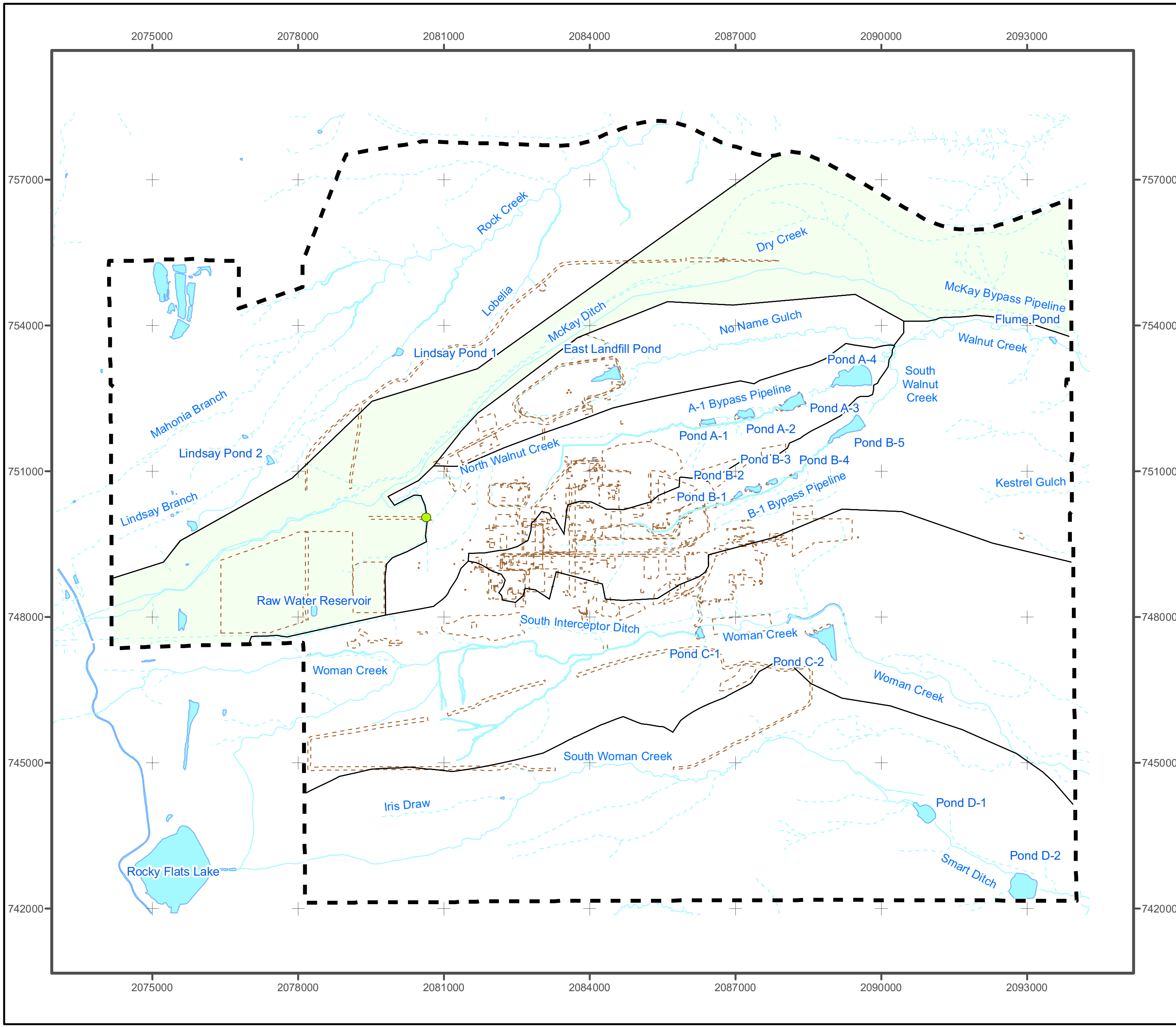

Figure 5.9
McKay Ditch AEU
Fluoride HQs
Sediment - LOEC

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on LOEC
(7 mg/kg)

Standard Map Features
- McKay Ditch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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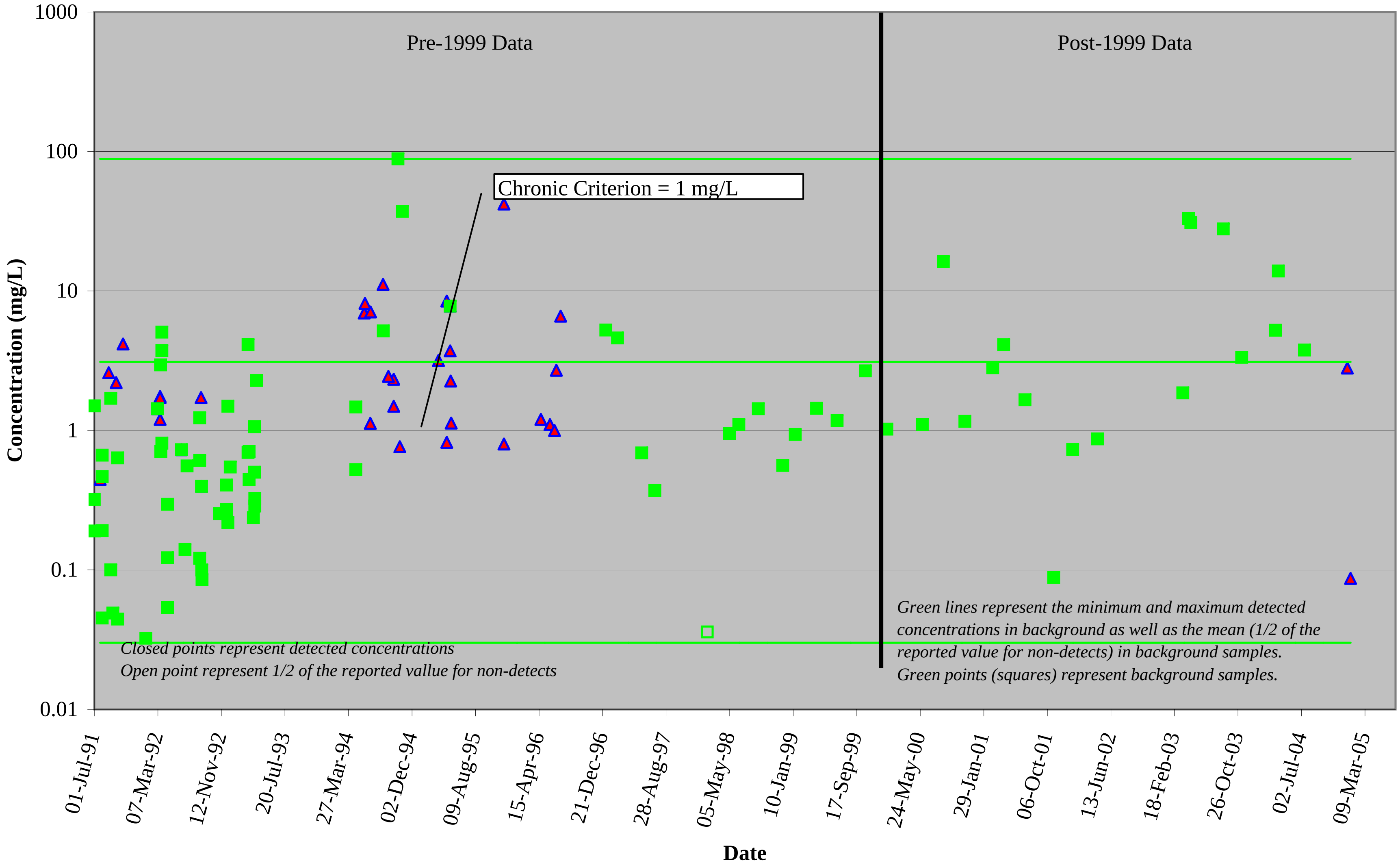
Rocky Flats Environmental
Technology Site

File: W:\Projects\FY2005\RIFS_Fig\CRA\Volume_15\Automated_sec5_AEU_Maps.mxd

Figure 5.10
Temporal Trends in Surface Water Iron (Total) Concentrations
McKay Ditch AEU



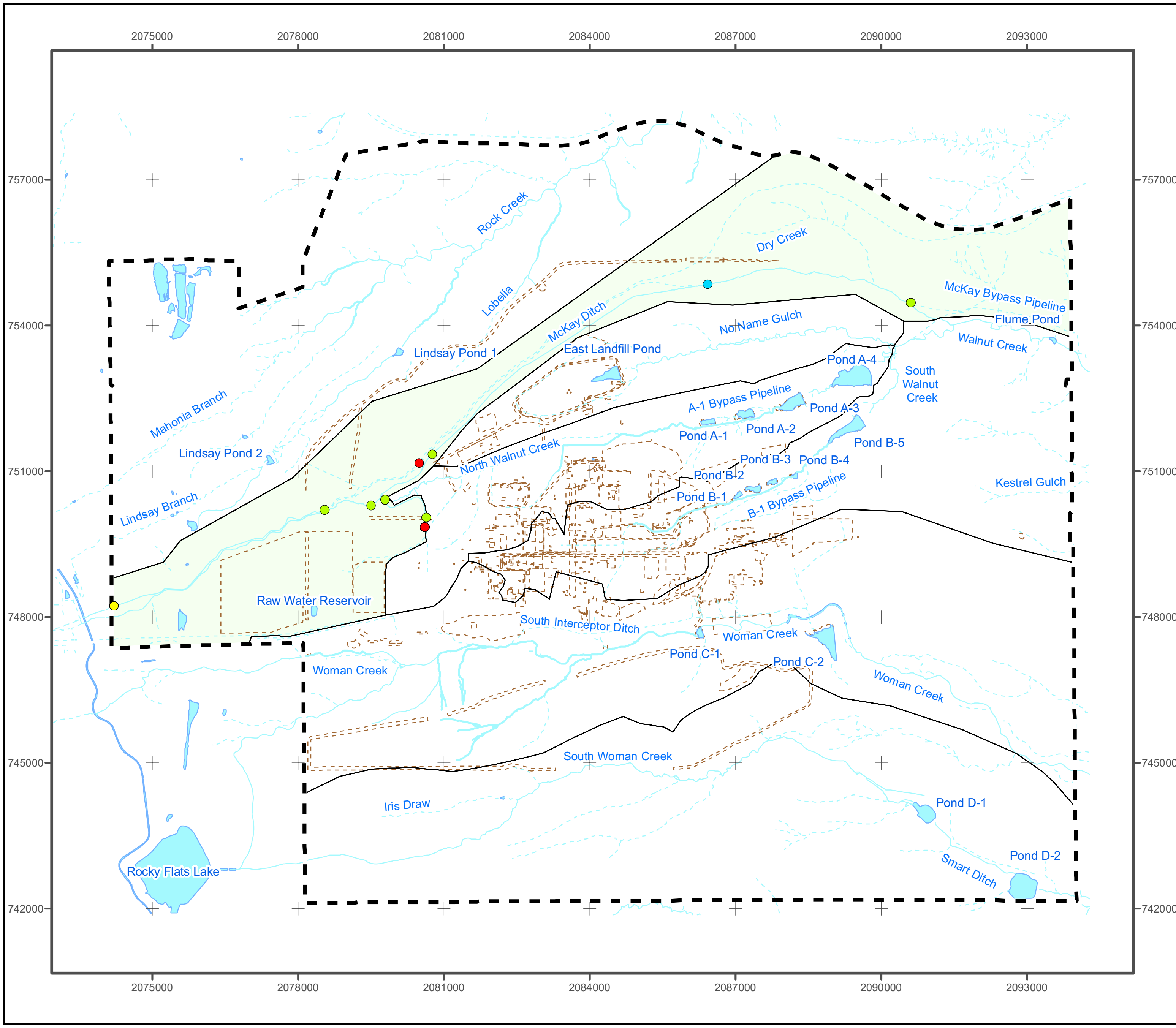


Figure 5.11
McKay Ditch AEU
Iron (total) HQs
Surface Water - Chronic ESL

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on Chronic ESL
(1 mg/L)

Standard Map Features
- McKay Ditch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 1,500 3,000
Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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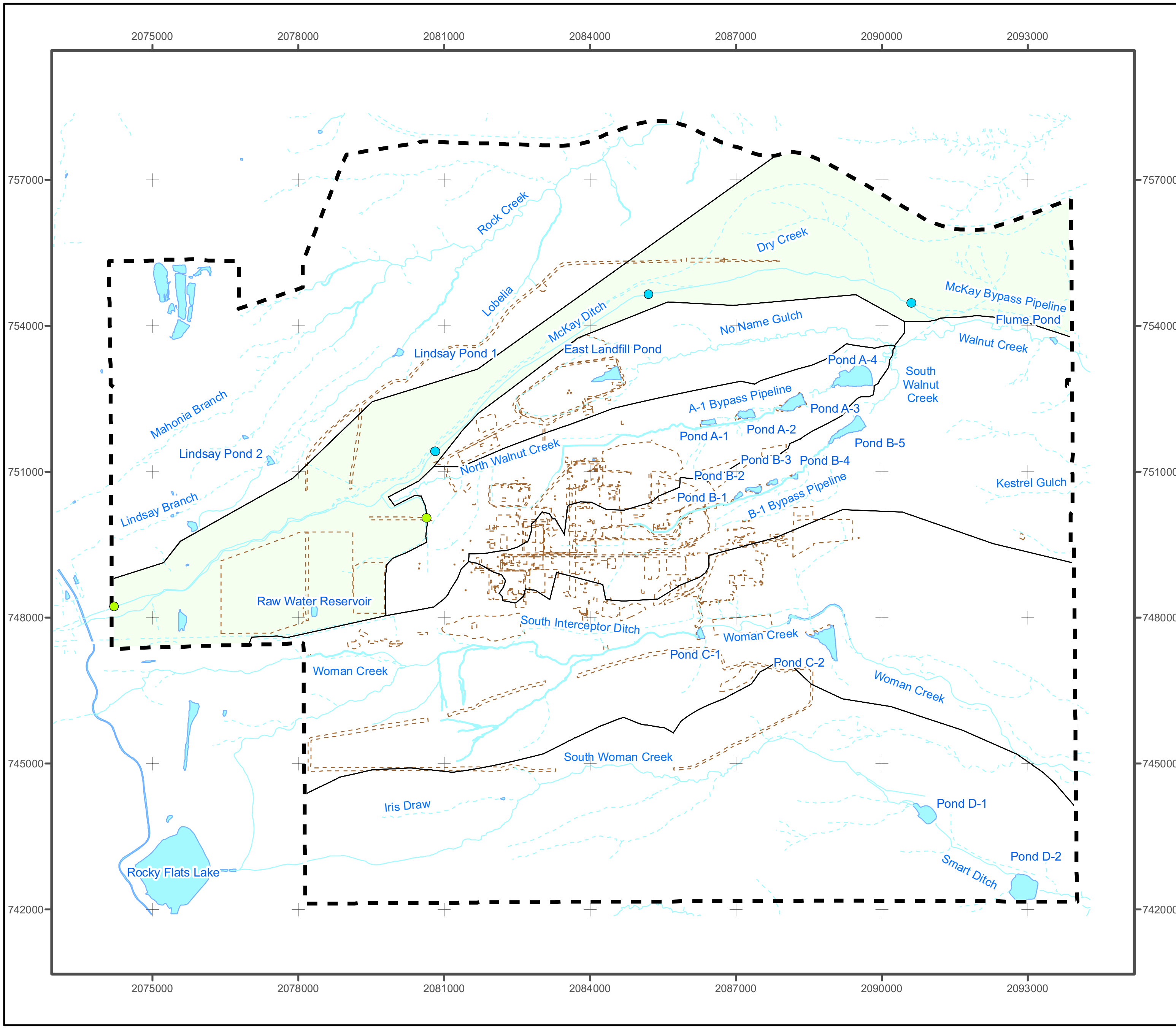

Figure 5.12
McKay Ditch AEU
Iron HQs
Sediment - NOEC ESL

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on NOEC ESL
(20000 mg/kg)

Standard Map Features
- McKay Ditch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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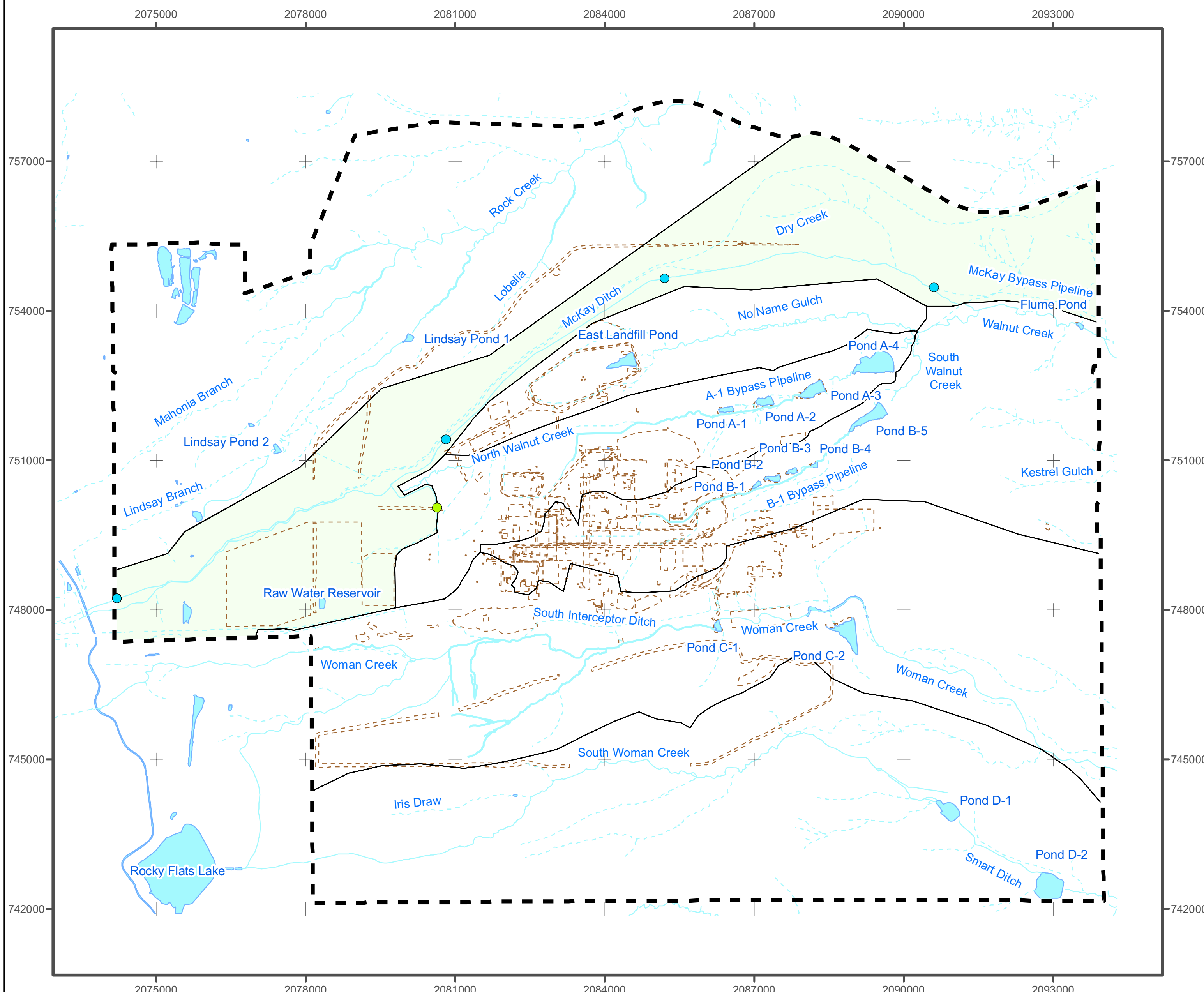
File: W:\Projects\FY2005\RIFS_Fig\CRA\Volume_15\Automated_sec5_AEU_Maps.mxd

Figure 5.13
McKay Ditch AEU
Nickel HQs
Sediment - NOEC ESL



KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on NOEC ESL
(22.7 mg/kg)

Note:
No LOEC HQs >1, so no LOEC figure provided.

Standard Map Features
- McKay Ditch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental
Technology Site

File: W:\Projects\FY2005\RIFS_Fig\CRA\Volume_15\Automated_sec5_AEU_Maps.mxd

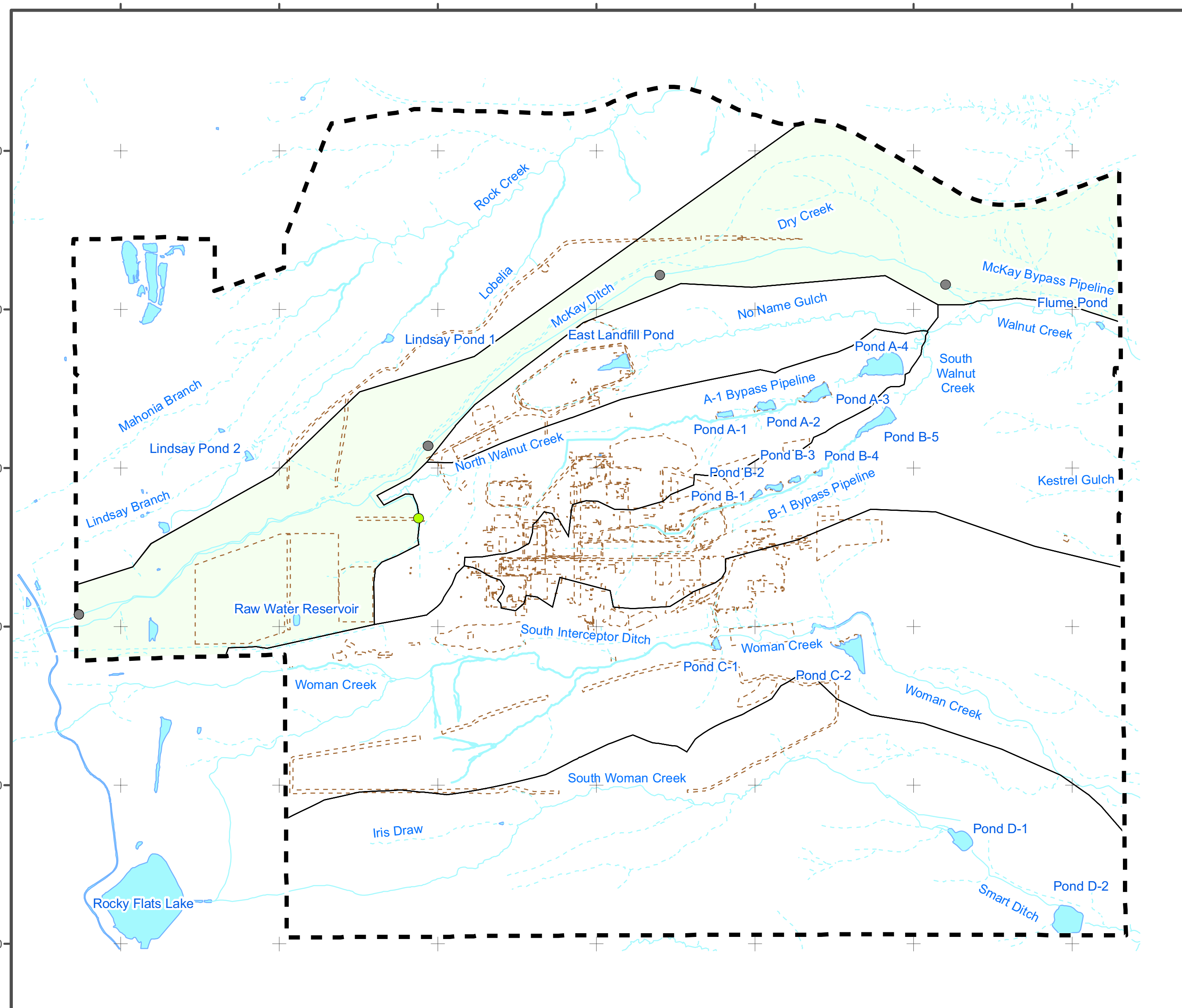


Figure 5.14
McKay Ditch AEU
Selenium HQs
Sediment - NOEC ESL

KEY

Sample location
HQ > 10
5 < HQ <= 10
1 < HQ <= 5
HQ < 1
Nondetect

HQ based on NOEC ESL
(0.95 mg/kg)

Standard Map Features
McKay Ditch AEU
Aquatic Exposure Unit boundary
Historical IHSS/PAC
Pond
Perennial stream
Intermittent stream
Ephemeral stream
Site boundary

N
W
E
S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental
Technology Site

File: W:\Projects\FY2005\RIFS_Fig\CRA\Volume_15\Automated_sec5_AEU_Maps.mxd

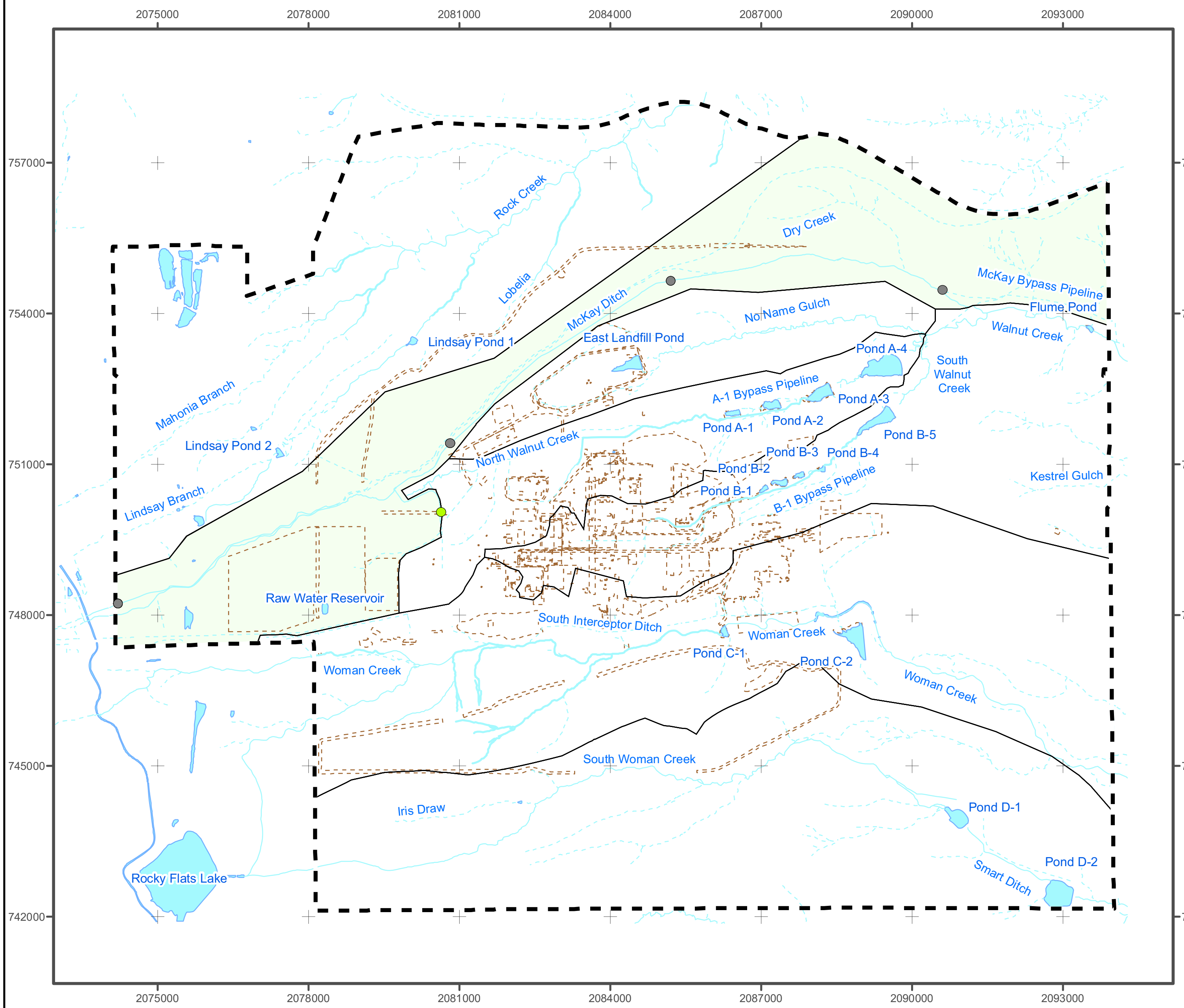


Figure 5.15
McKay Ditch AEU
Selenium HQs
Sediment - LOEC

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on LOEC
(1.73 mg/kg)

Standard Map Features
- McKay Ditch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental
Technology Site

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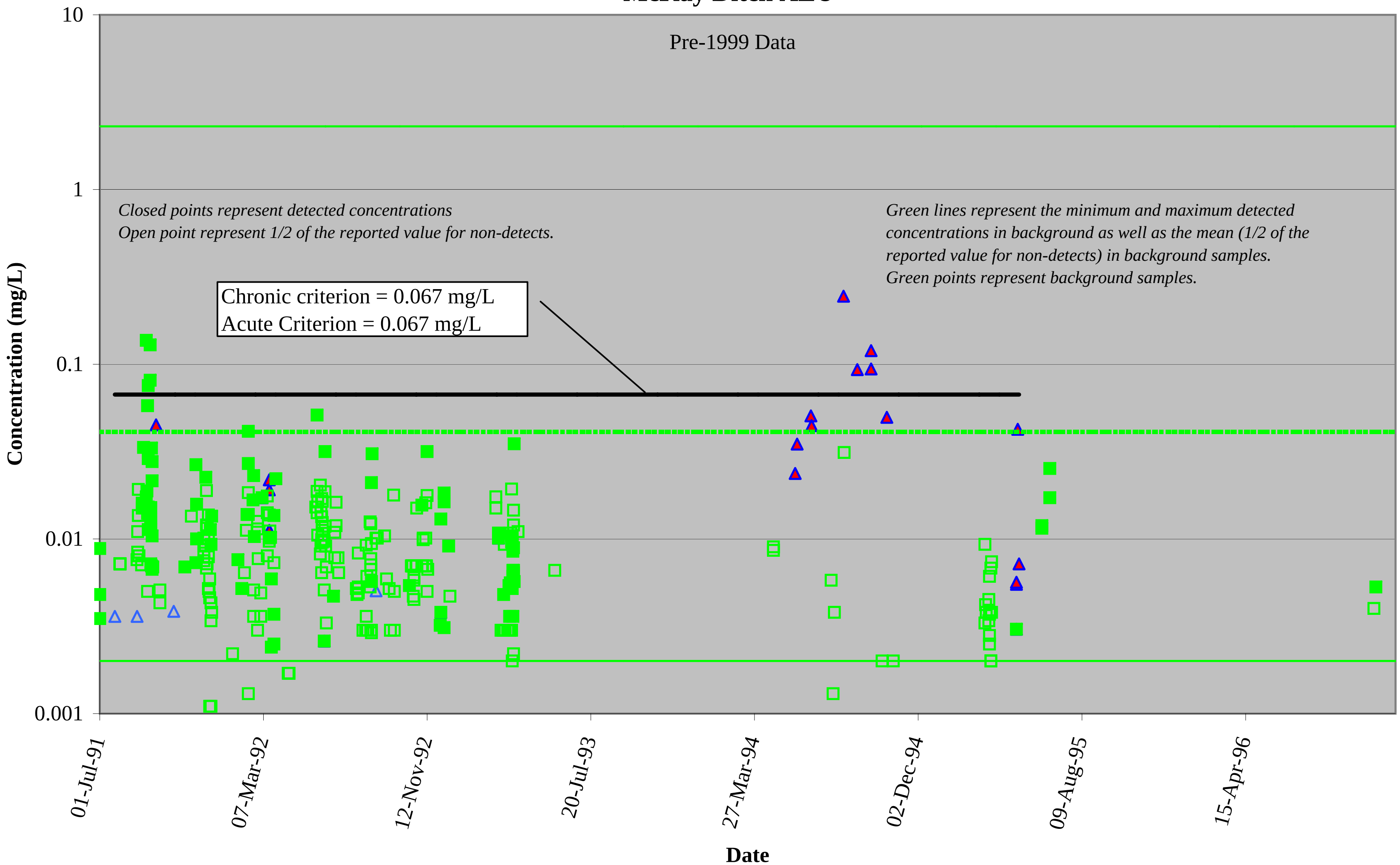
Volume_15\Automated_sec5_AEU_Maps.mxd

Figure 5.16
Temporal Trends in Surface Water Zinc (dissolved) Concentrations
McKay Ditch AEU



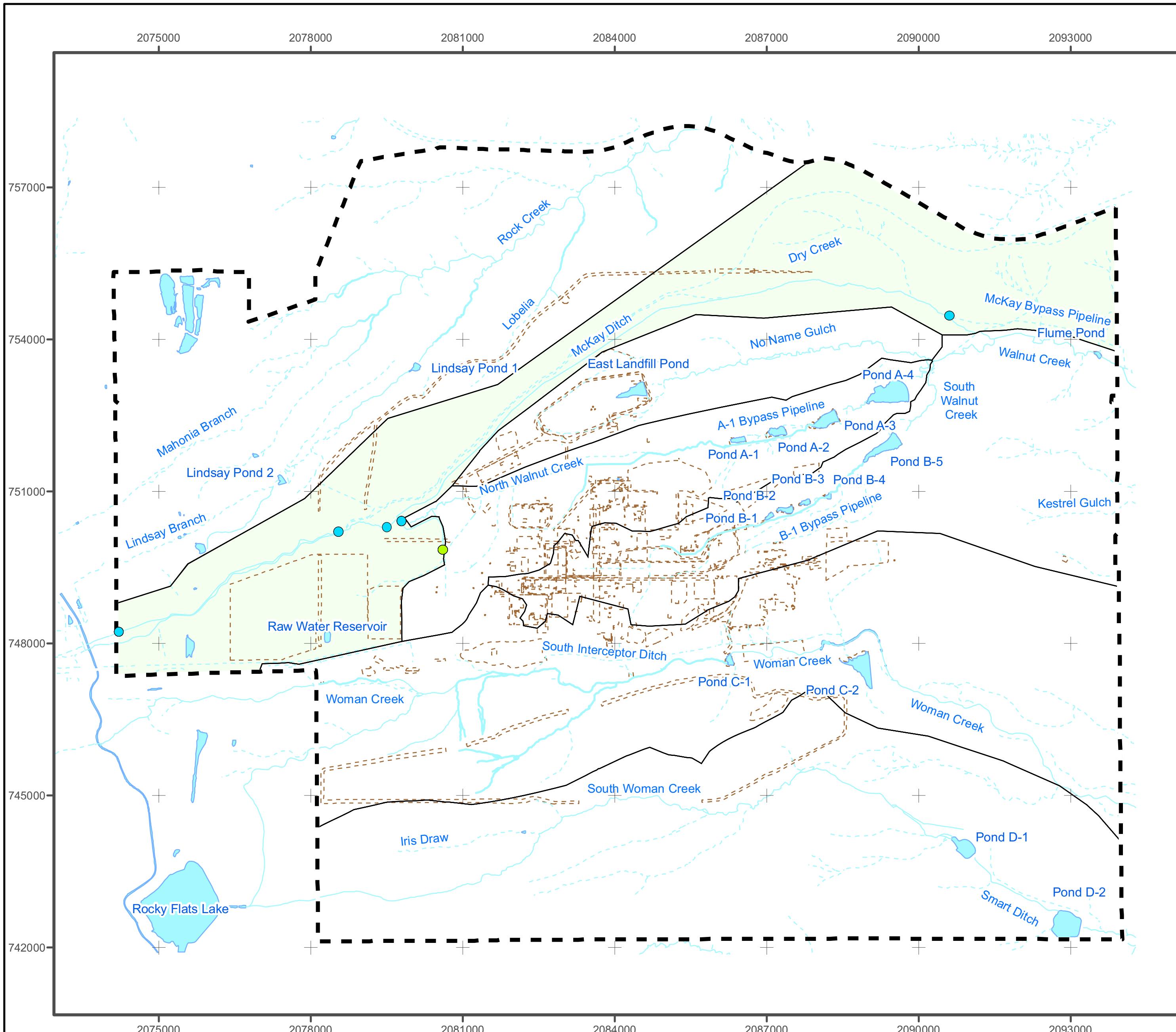


Figure 5.17
McKay Ditch AEU
Zinc (dissolved) HQs
Surface Water - Chronic ESL

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on Chronic ESL
(0.0671 mg/L)

Standard Map Features
- McKay Ditch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
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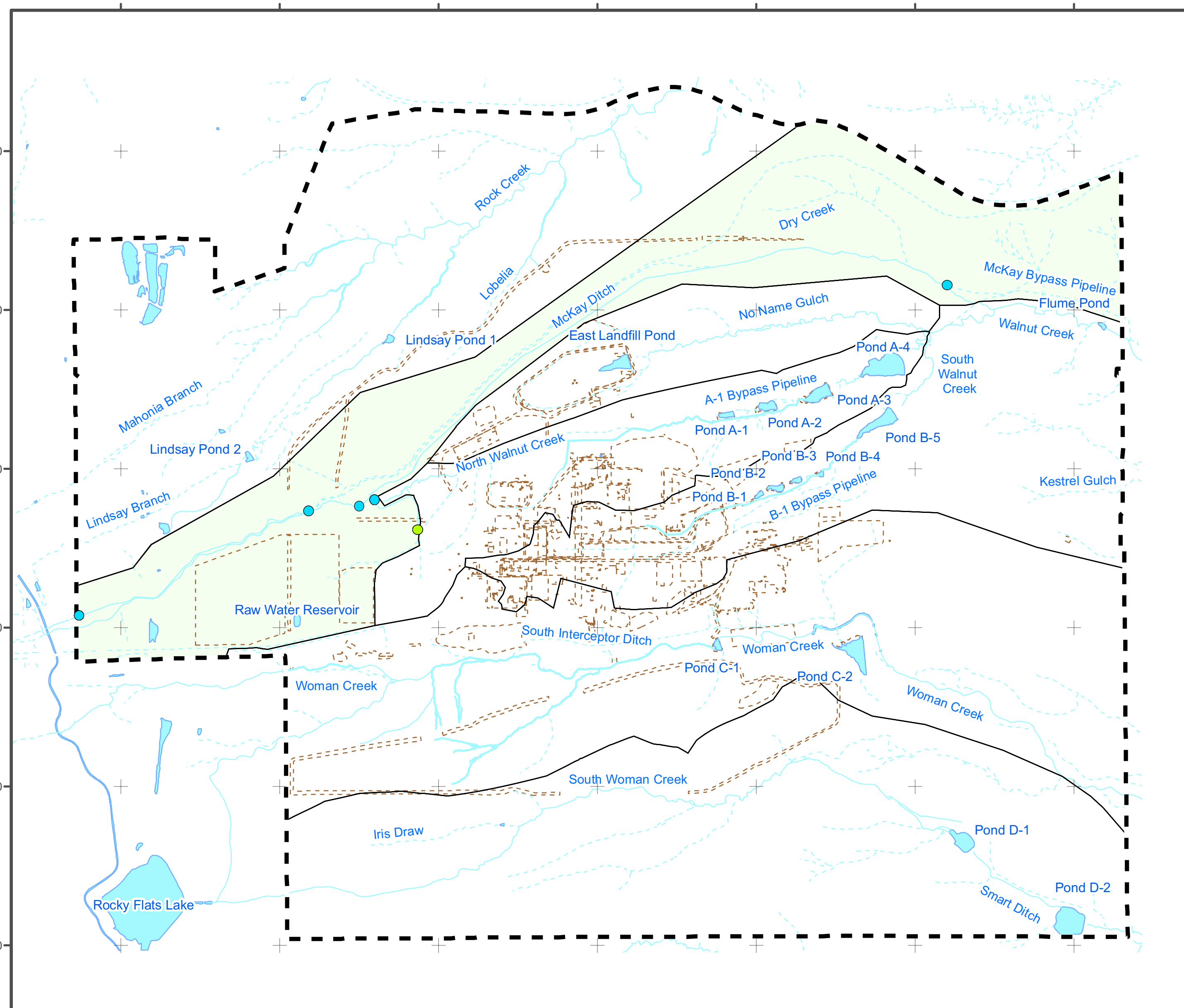

Figure 5.18
McKay Ditch AEU
Zinc (dissolved) HQs
Surface Water - Acute Criterion

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on Acute AWQC
(0.0666 mg/L)

Standard Map Features
- McKay Ditch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Technology Site

File: W:\Projects\FY2005\RIFS_Fig\CRA\
Volume_15\Automated_sec5_AEU_Maps.mxd

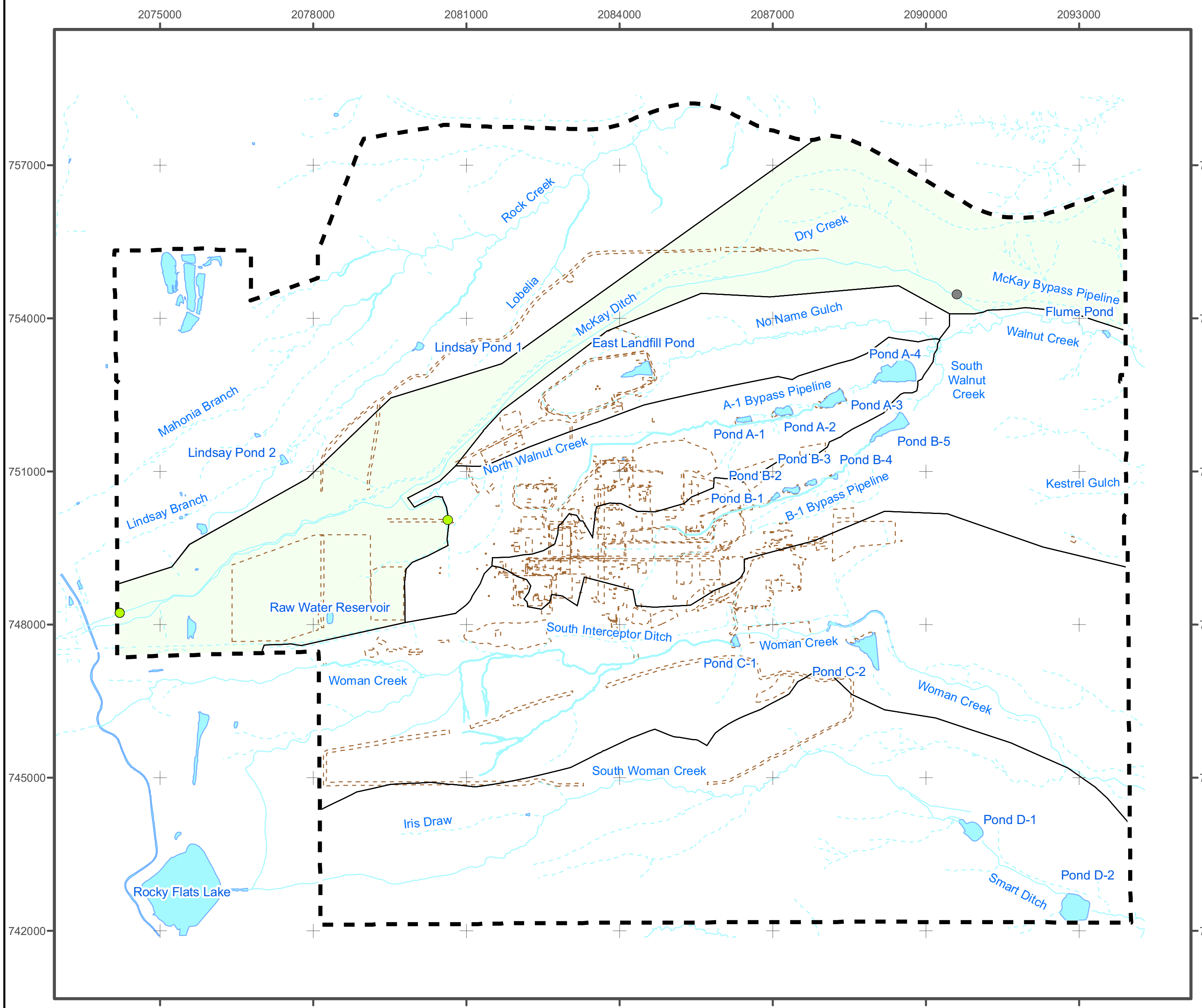

Figure 5.19
McKay Ditch AEU
Total PAHs HQs
Sediment - NOEC ESL

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on NOEC ESL
(1610 ug/kg)

Note:
Some nondetect results exceed the NOEC ESL. See Table 5.4.

No LOEC HQs >1, so no LOEC figure provided.

Standard Map Features
- McKay Ditch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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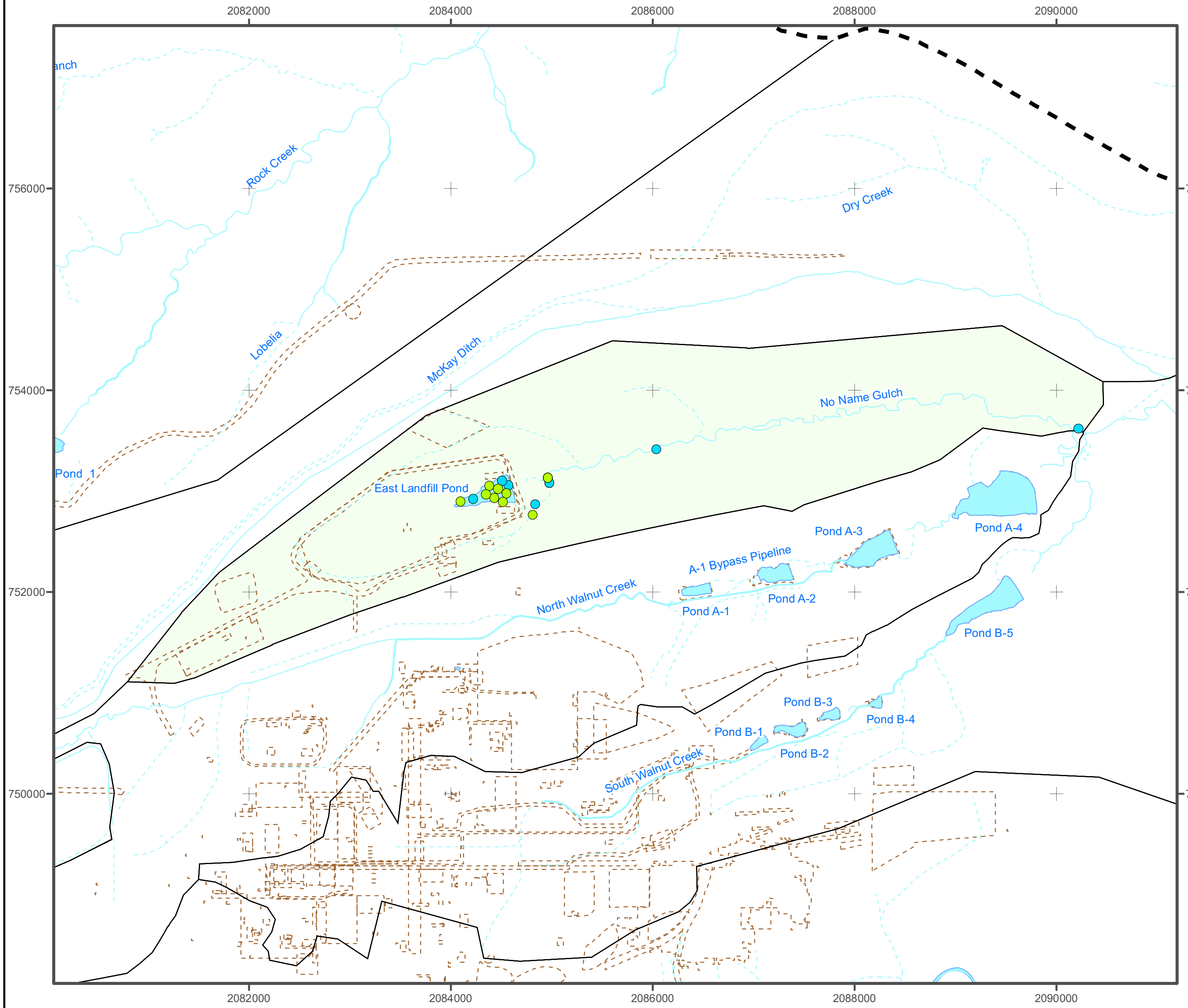
Figure 5.20
No Name Gulch AEU
Aluminum HQs
Sediment - NOEC ESL



KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on NOEC ESL
(15900 mg/kg)

Note:
No LOEC HQs >1, so no LOEC figure provided.

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 750 1,500 Feet

Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
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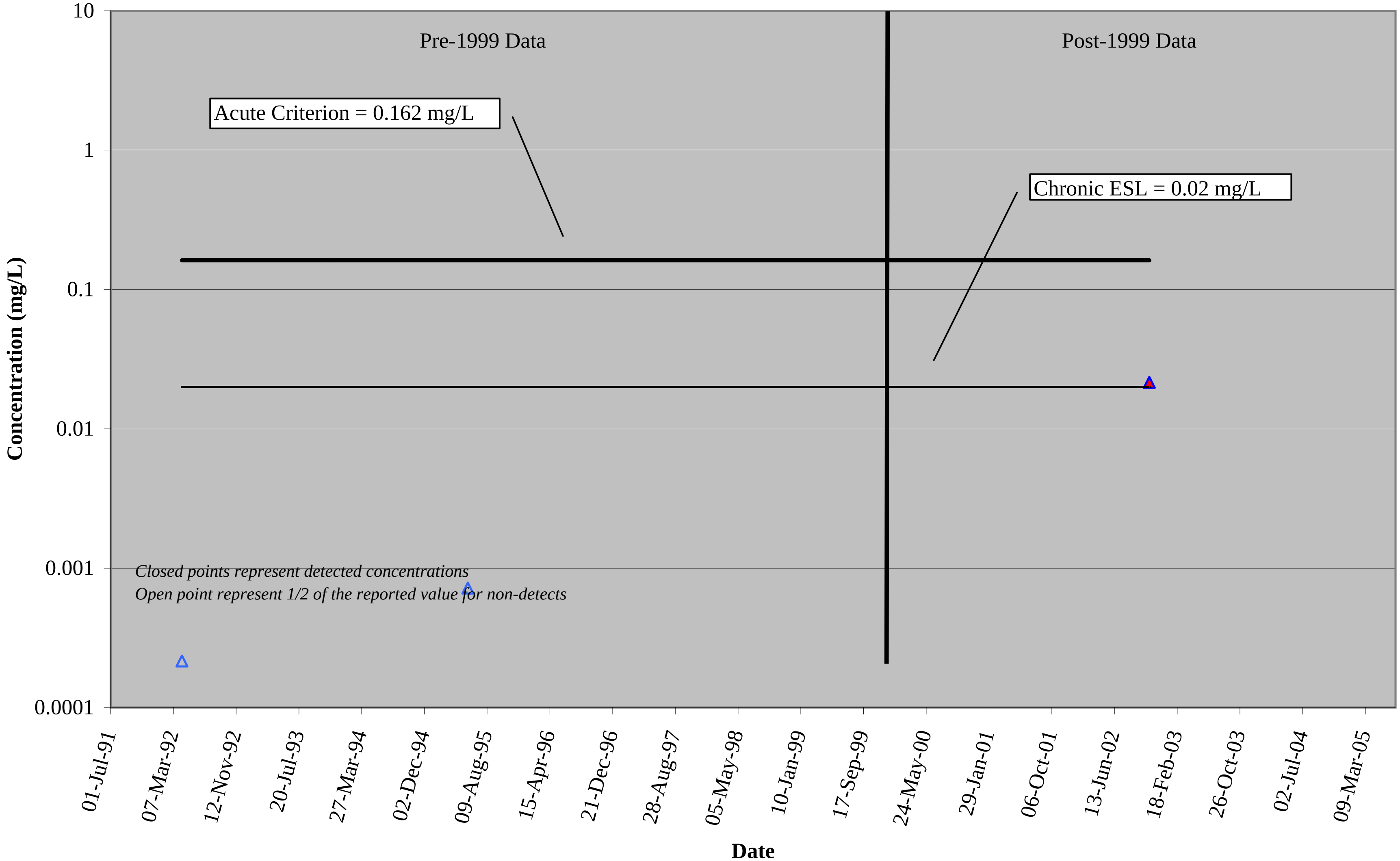
Volume_15\Automated_sec5_AEU_Maps.mxd

Figure 5.21
Temporal Trends in Surface Water Ammonia (un-ionized) Concentrations
No Name Gulch Drainage AEU



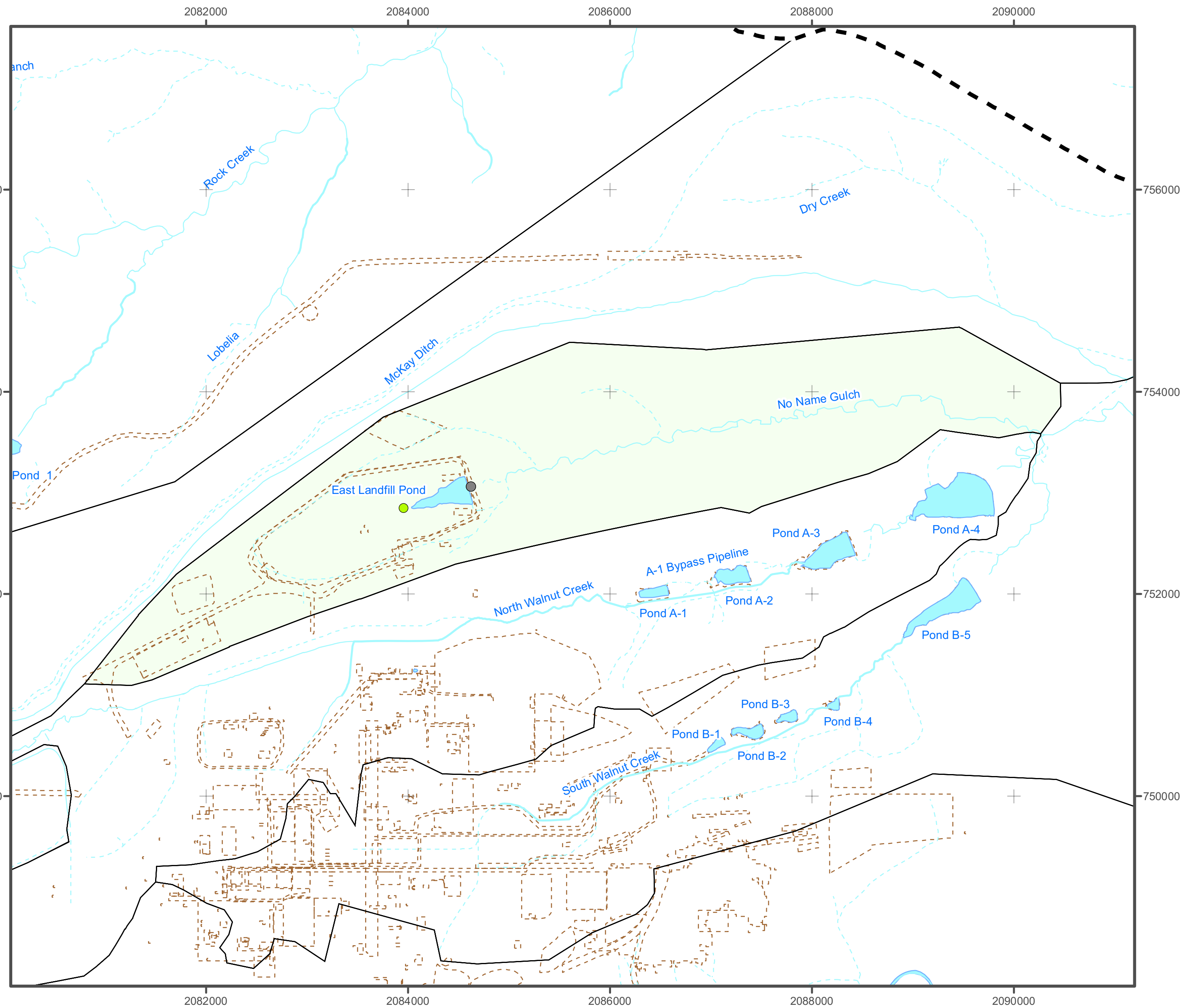


Figure 5.22
No Name Gulch AEU
Ammonia-Unionized HQs
Surface Water - Chronic ESL

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on Chronic ESL
(0.02 mg/L)

Note:
No Acute Criterion HQs >1,
so no figure provided.

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 750 1,500 Feet

Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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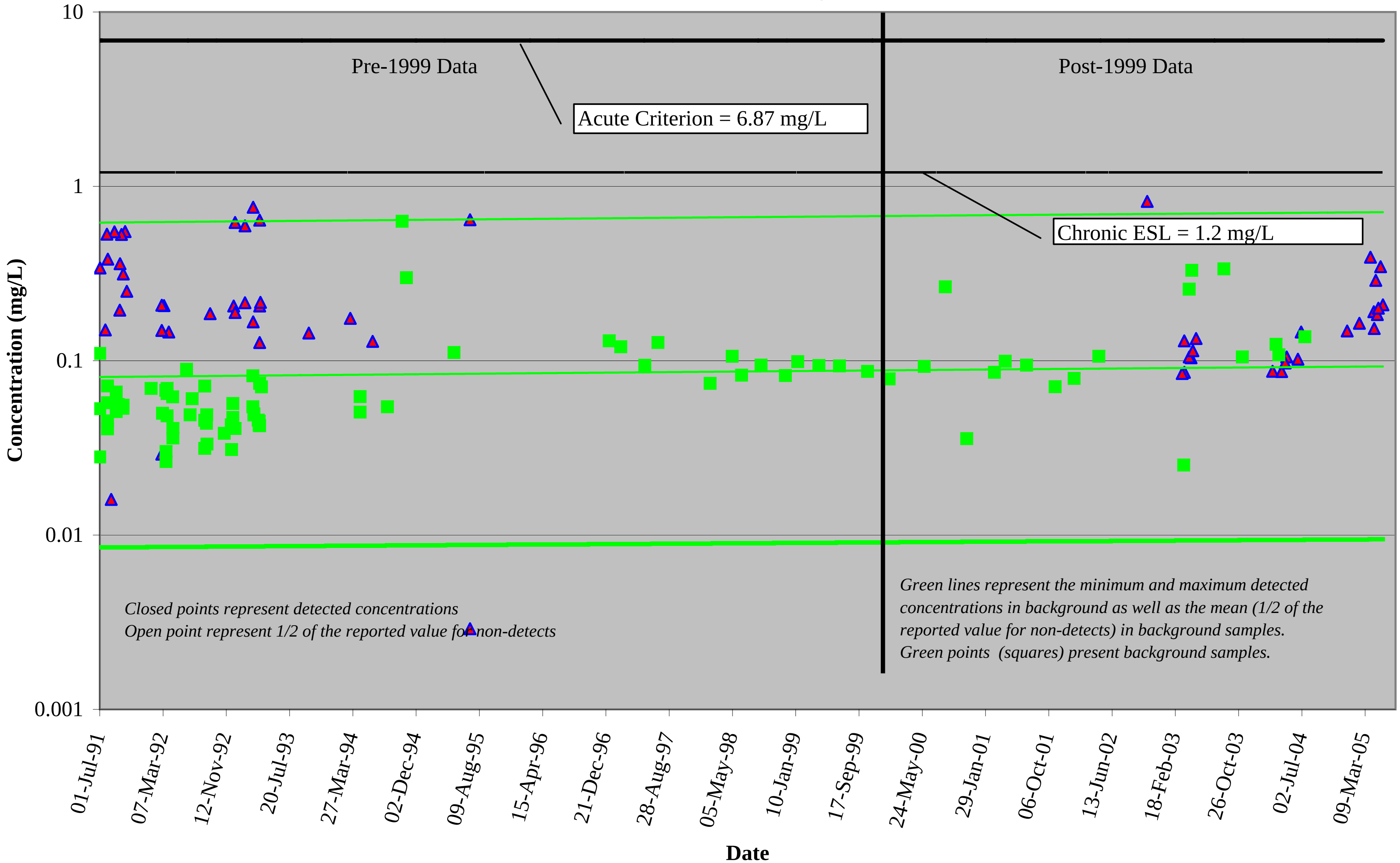
Volume_15\Automated_sec5_AEU_Maps.mxd

Figure 5.23
Temporal Trends in Surface Water Barium (Total) Concentrations
No Name Gulch Drainage AEU



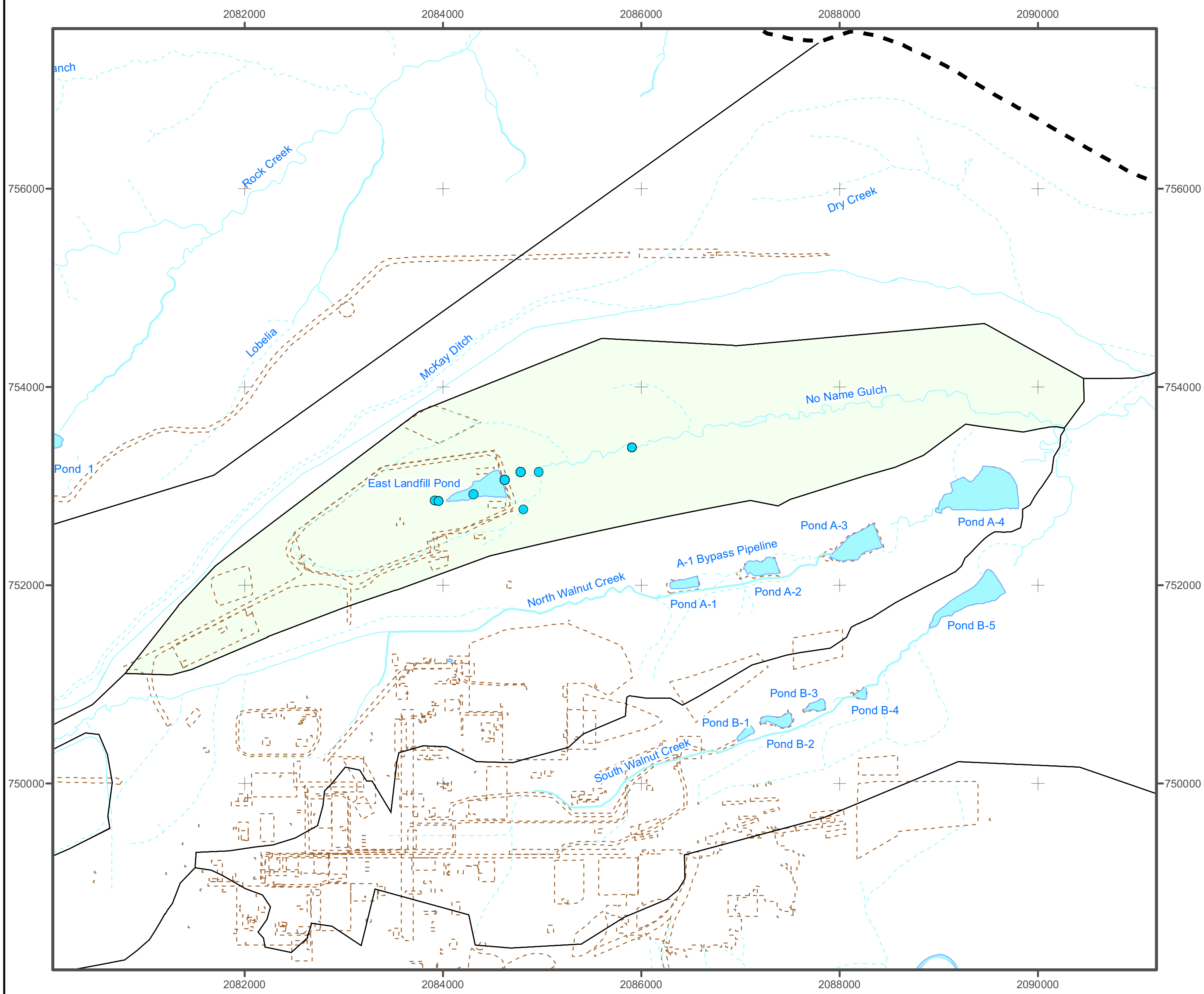


Figure 5.24
No Name Gulch AEU
Barium (total) HQs
Surface Water - Chronic ESL

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on Chronic ESL
(1.204 mg/L)

Note:
No Acute Criterion HQs >1,
so no figure provided.

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 750 1,500 Feet
Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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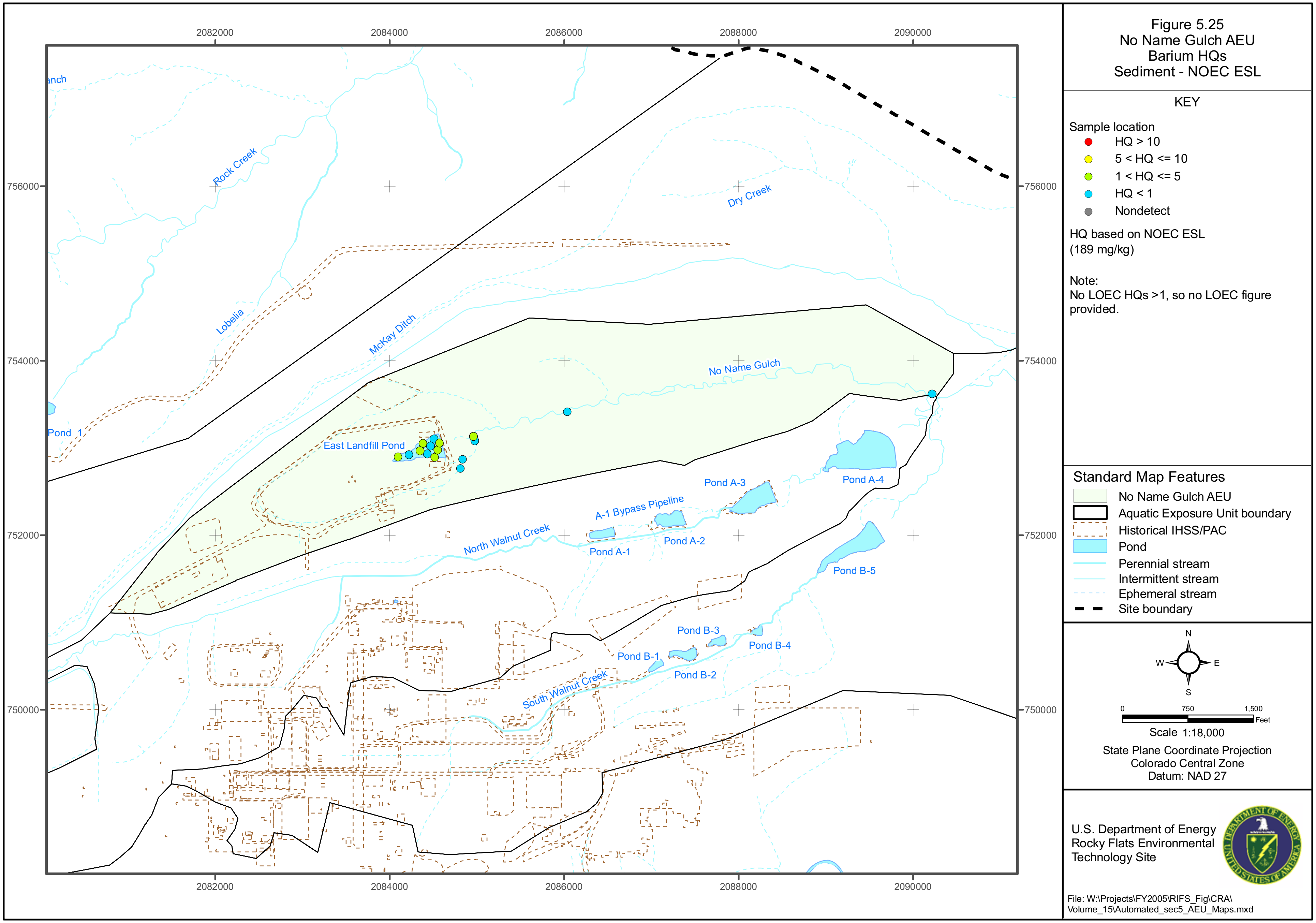

Figure 5.25
No Name Gulch AEU
Barium HQs
Sediment - NOEC ESL
KEY
Sample location
HQ > 10
5 < HQ <= 10
1 < HQ <= 5
HQ < 1
Nondetect
HQ based on NOEC ESL
(189 mg/kg)
Note:
No LOEC HQs >1, so no LOEC figure provided.
Standard Map Features
No Name Gulch AEU
Aquatic Exposure Unit boundary
Historical IHSS/PAC
Pond
Perennial stream
Intermittent stream
Ephemeral stream
Site boundary
N
W
E
S
0
750
1,500
Feet
Scale 1:18,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27
U.S. Department of Energy
Rocky Flats Environmental Technology Site
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2082000
2084000
2086000
2088000
2090000
756000
754000
752000
750000
Rock Creek
Dry Creek
Lobelia
McKay Ditch
No Name Gulch
Pond 1
East Landfill Pond
Pond A-3
Pond A-4
A-1 Bypass Pipeline
North Walnut Creek
Pond A-1
Pond A-2
Pond B-5
Pond B-3
Pond B-4
Pond B-1
Pond B-2
South Walnut Creek

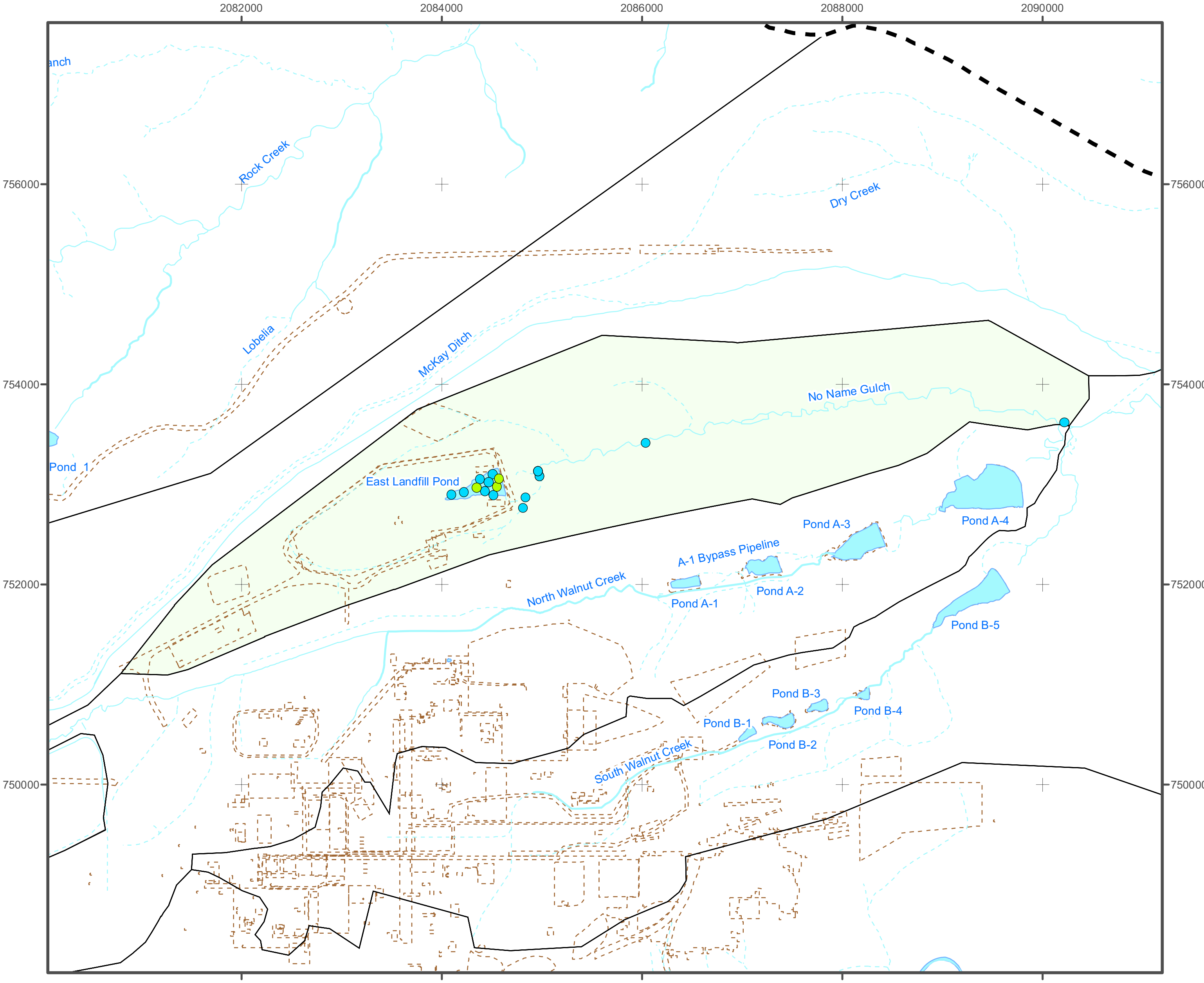

Figure 5.26
No Name Gulch AEU
Barium HQs
Sediment - LOEC

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on LOEC
(287 mg/kg)

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 750 1,500 Feet

Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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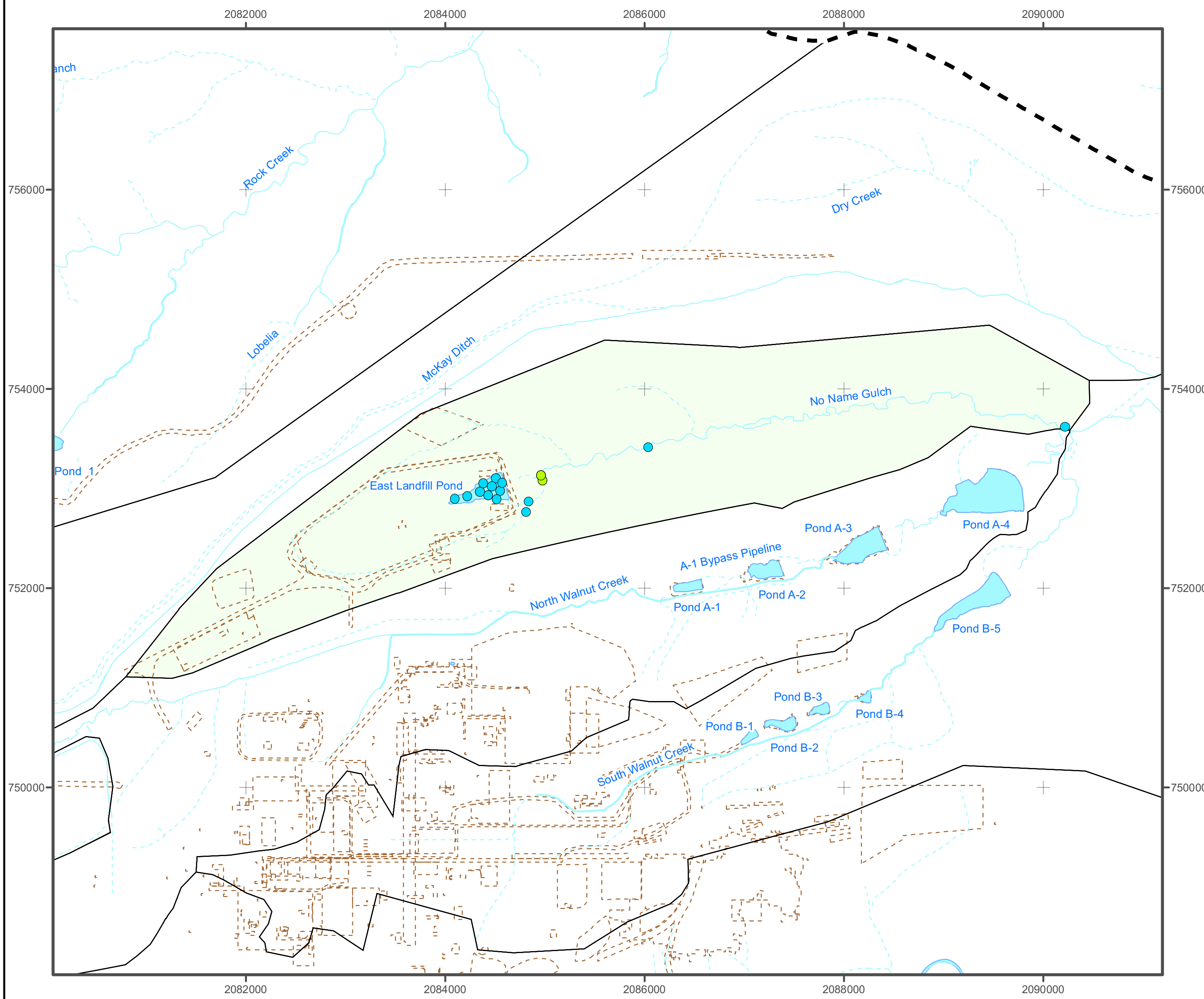

Figure 5.27
No Name Gulch AEU
Iron HQs
Sediment - NOEC ESL

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on NOEC ESL
(20000 mg/kg)

Note:
No LOEC HQs >1, so no LOEC figure provided.

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 750 1,500 Feet
Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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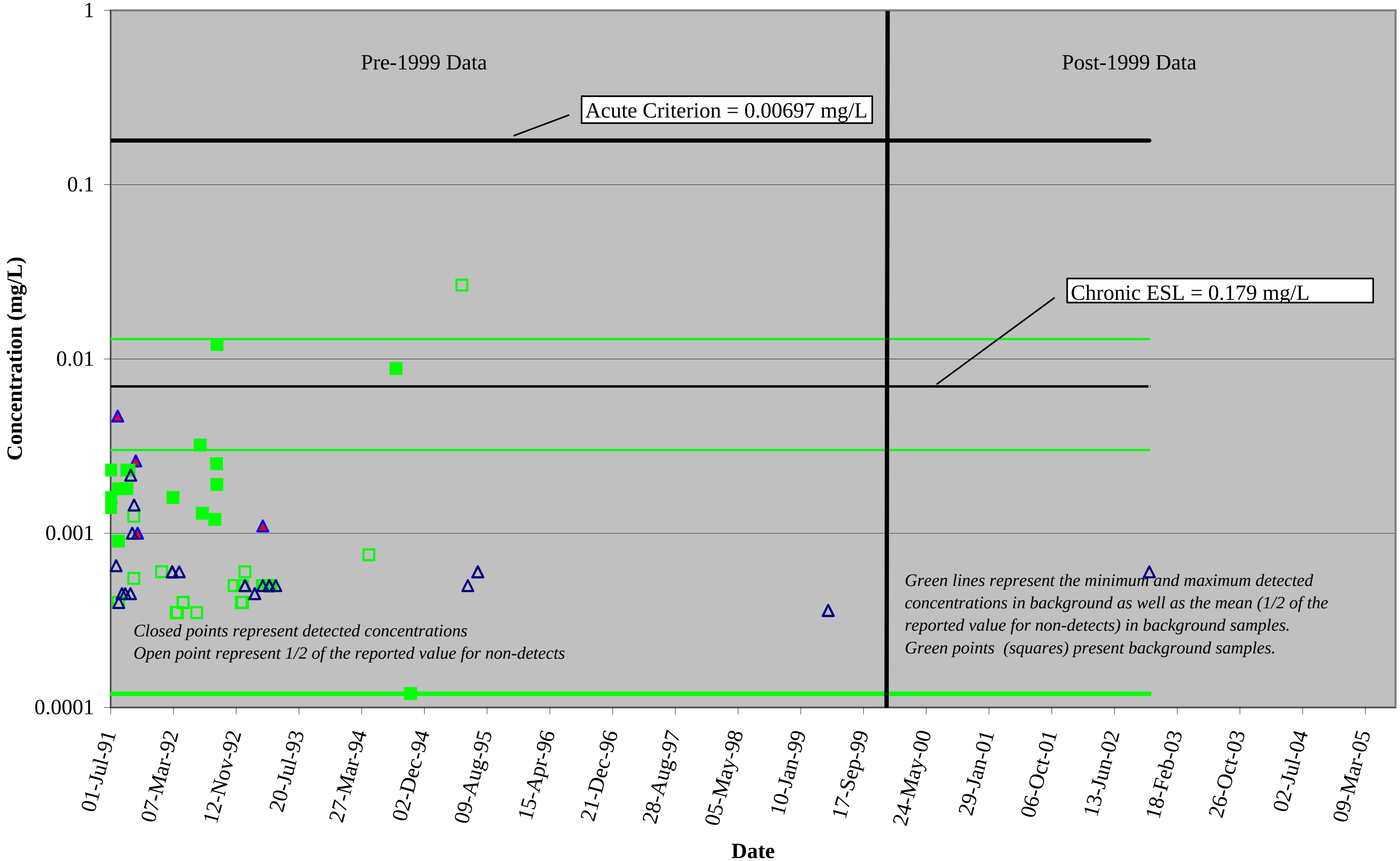
Figure 5.28
Temporal Trends in Surface Water Lead (Dissolved) Concentrations
No Name Gulch Drainage AEU



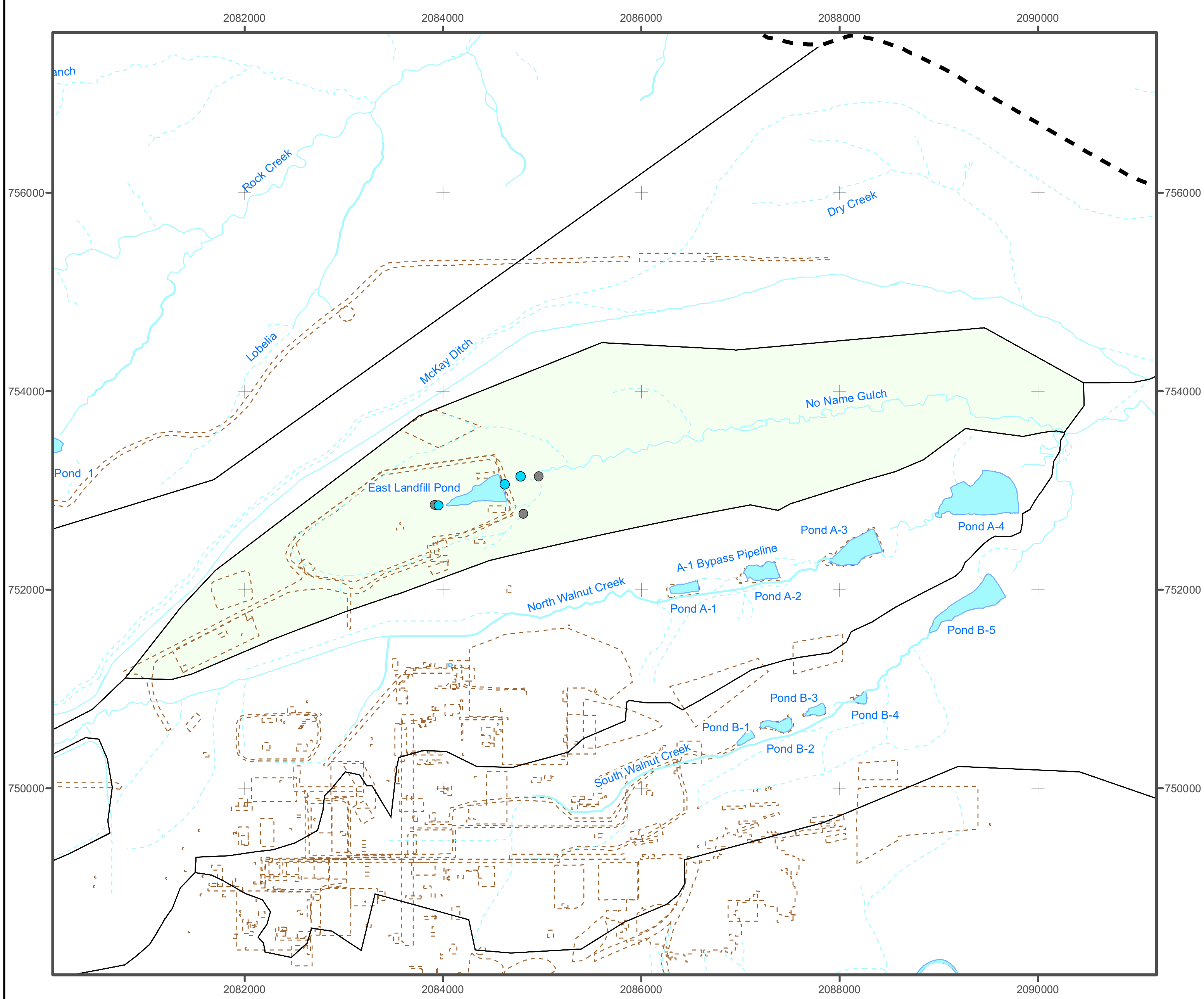


Figure 5.29
No Name Gulch AEU
Lead (dissolved) HQs
Surface Water - Chronic ESL

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on Chronic ESL
(0.00697 mg/L)

Note:
No Acute Criterion HQs >1,
so no figure provided.

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 750 1,500 Feet

Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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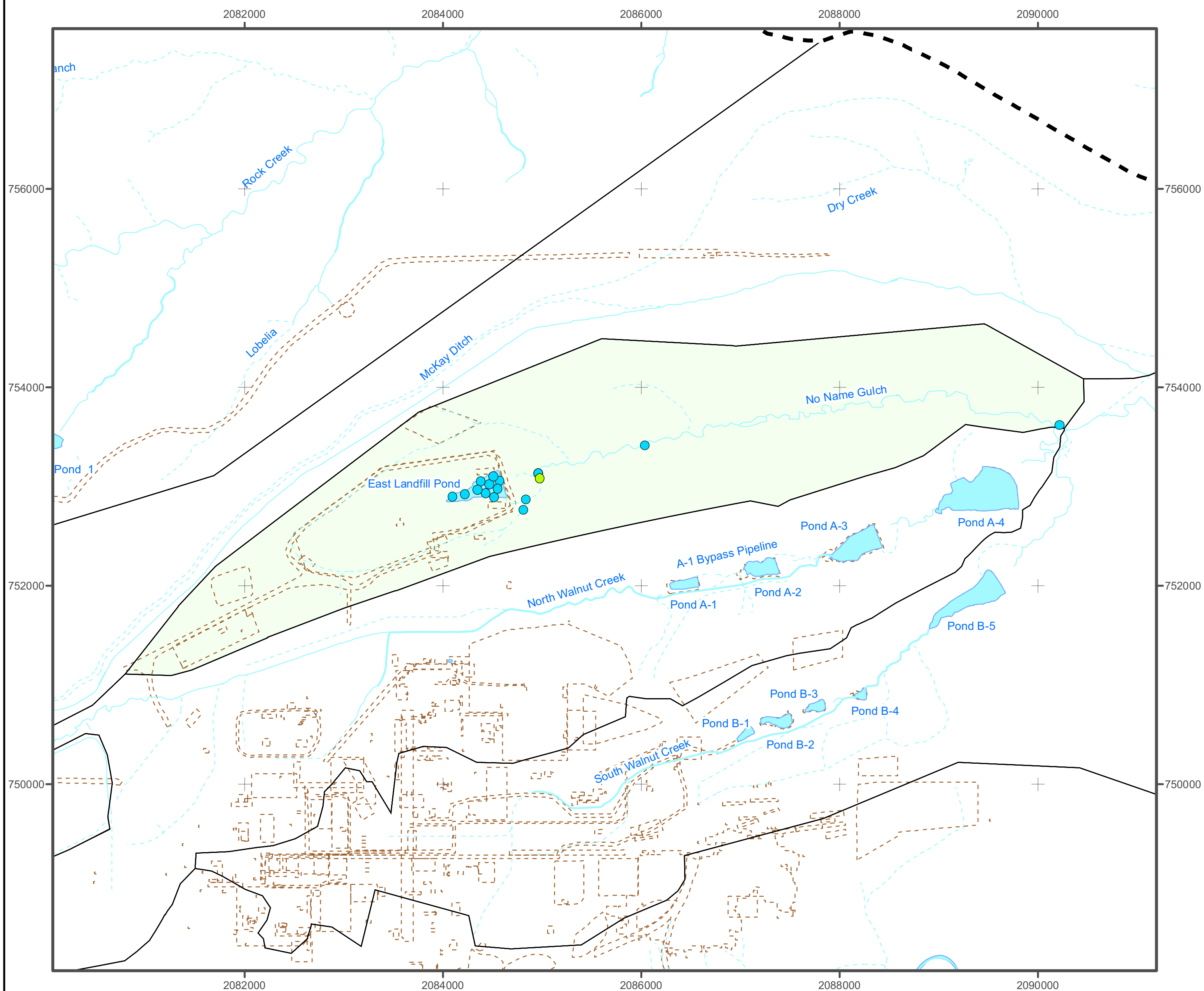
Figure 5.30
No Name Gulch AEU
Lead HQs
Sediment - NOEC ESL



KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on NOEC ESL
(35.8 mg/kg)

Note:
No LOEC HQs >1, so no LOEC figure provided.

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 750 1,500 Feet

Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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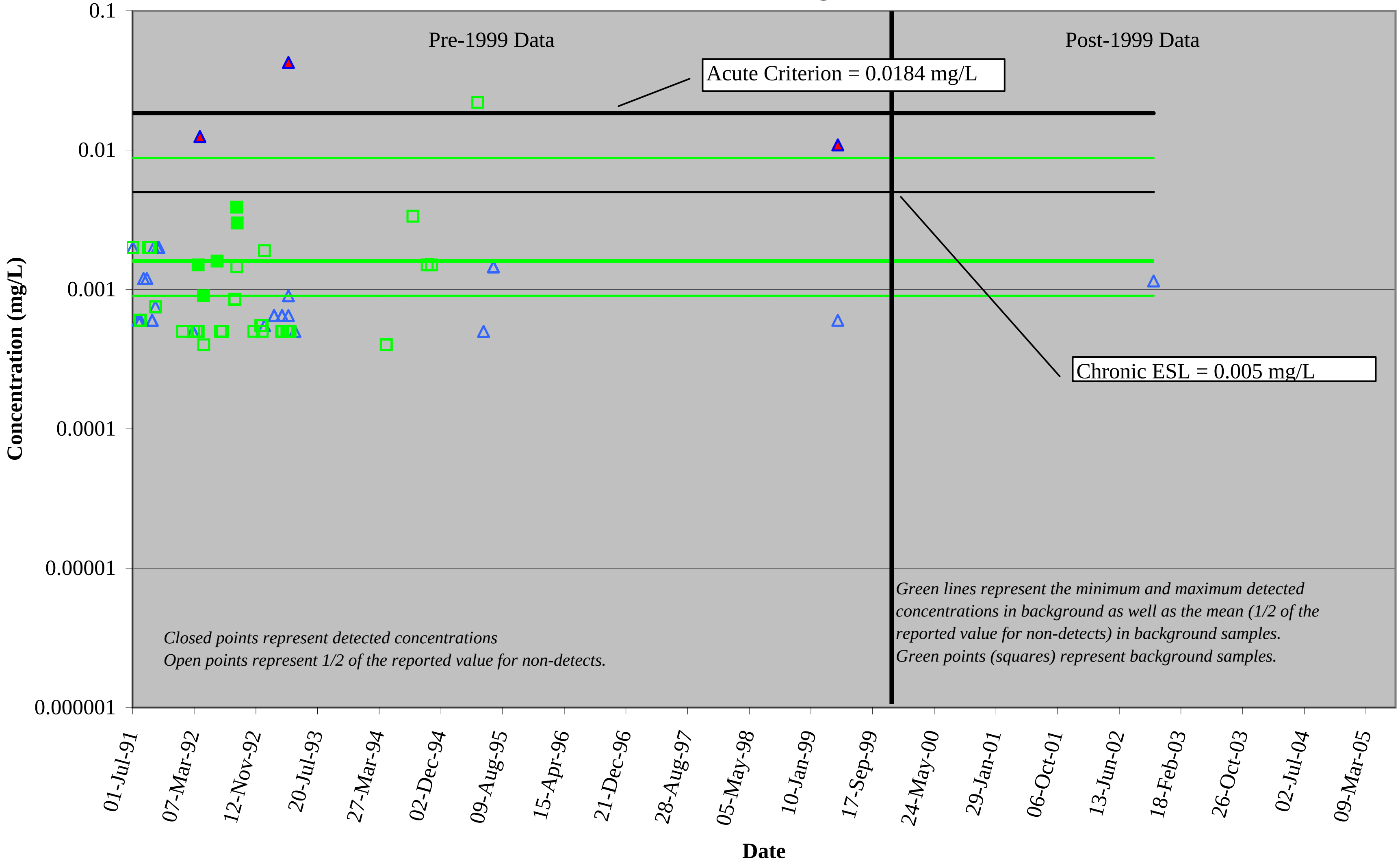
Figure 5.31
Temporal Trends in Surface Water Selenium (Dissolved) Concentrations
No Name Gulch Drainage AEU



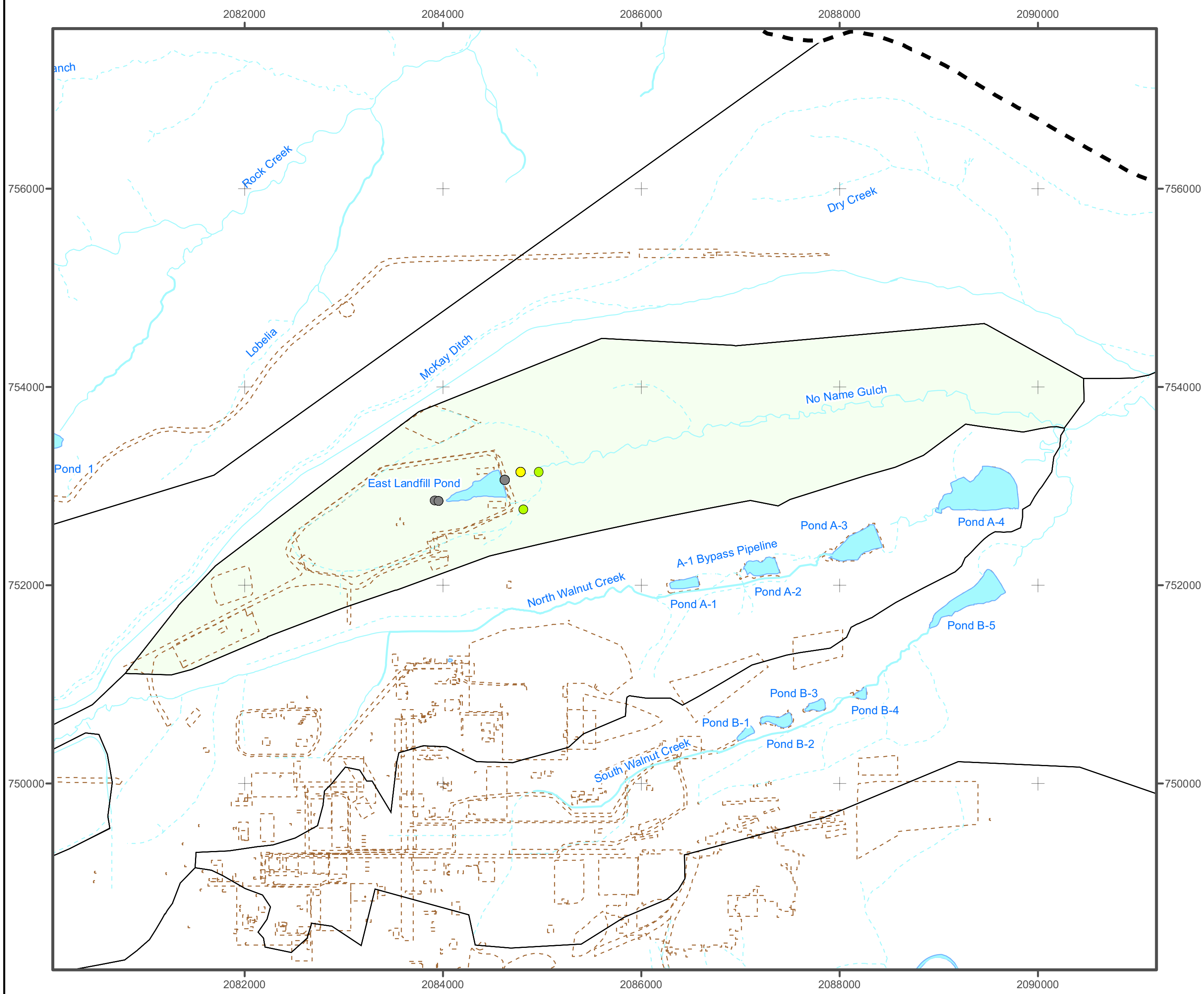


Figure 5.32
No Name Gulch AEU
Selenium (dissolved) HQs
Surface Water - Chronic ESL

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on Chronic ESL
(0.0046 mg/L)

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 750 1,500 Feet

Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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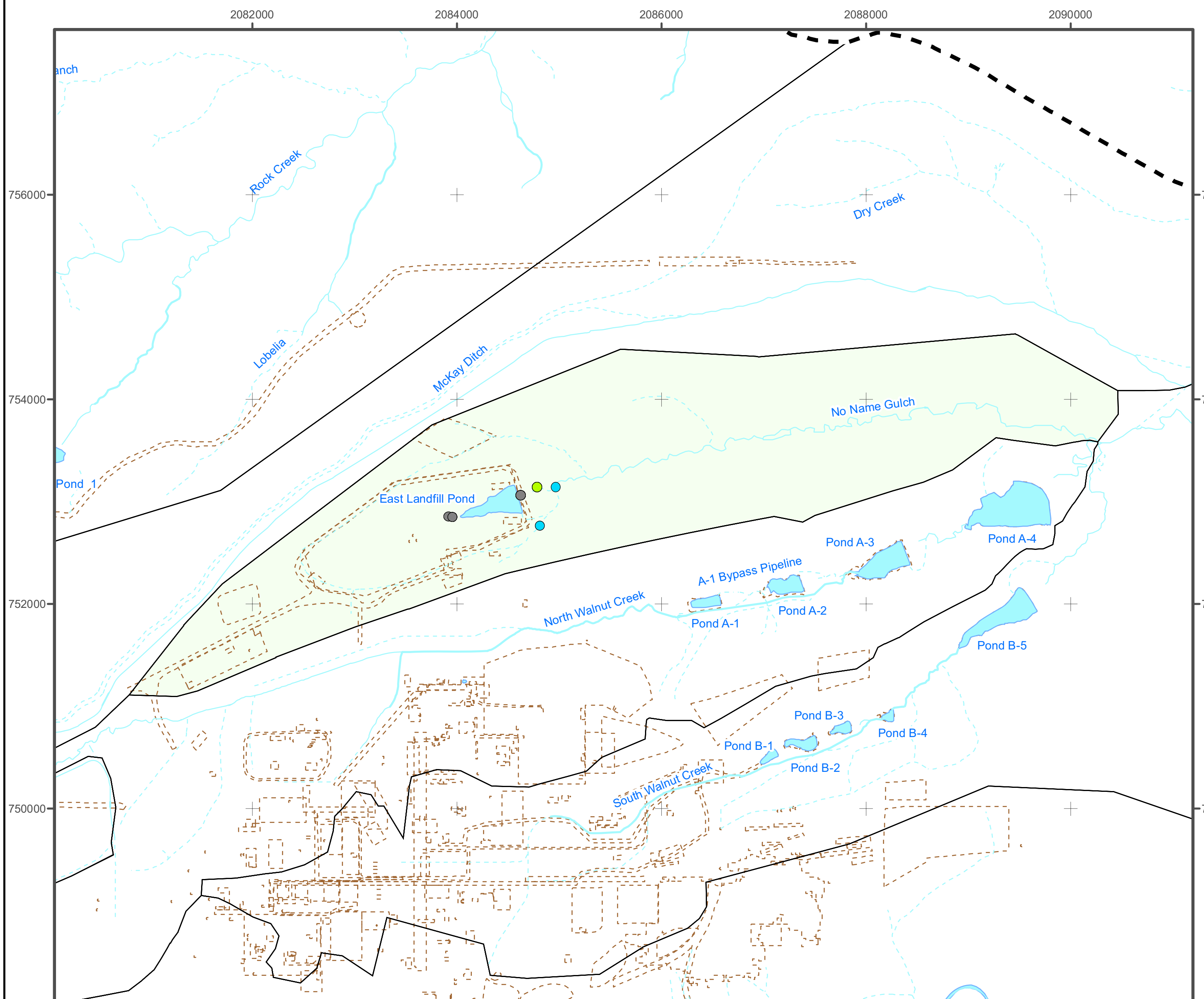

Figure 5.33
No Name Gulch AEU
Selenium (dissolved) HQs
Surface Water - Acute Criterion

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on Acute AWQC
(0.0184 mg/L)

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 750 1,500 Feet

Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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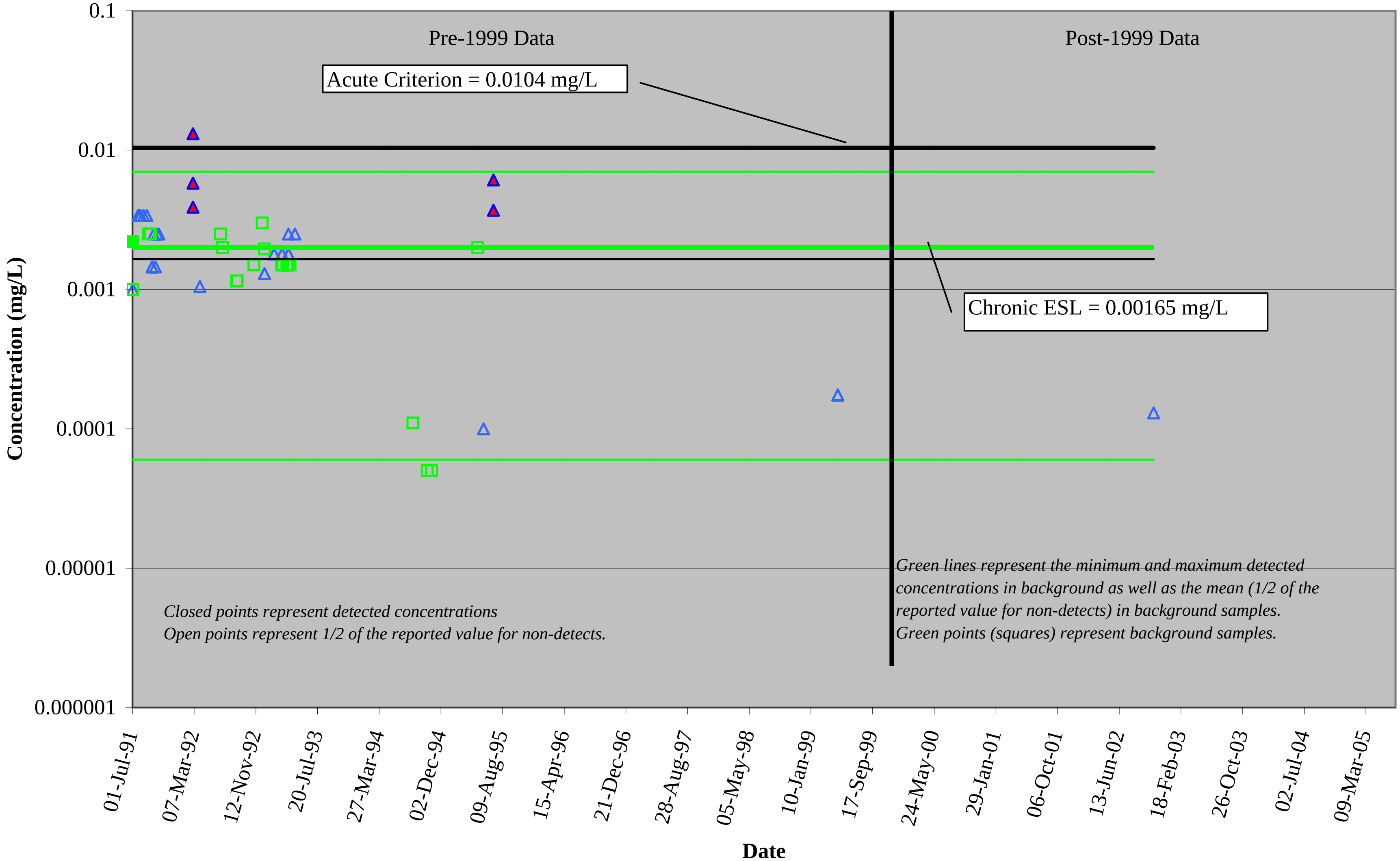
Volume_15\Automated_sec5_AEU_Maps.mxd

Figure 5.34
Temporal Trends in Surface Water Silver (Dissolved) Concentrations
No Name Gulch Drainage AEU



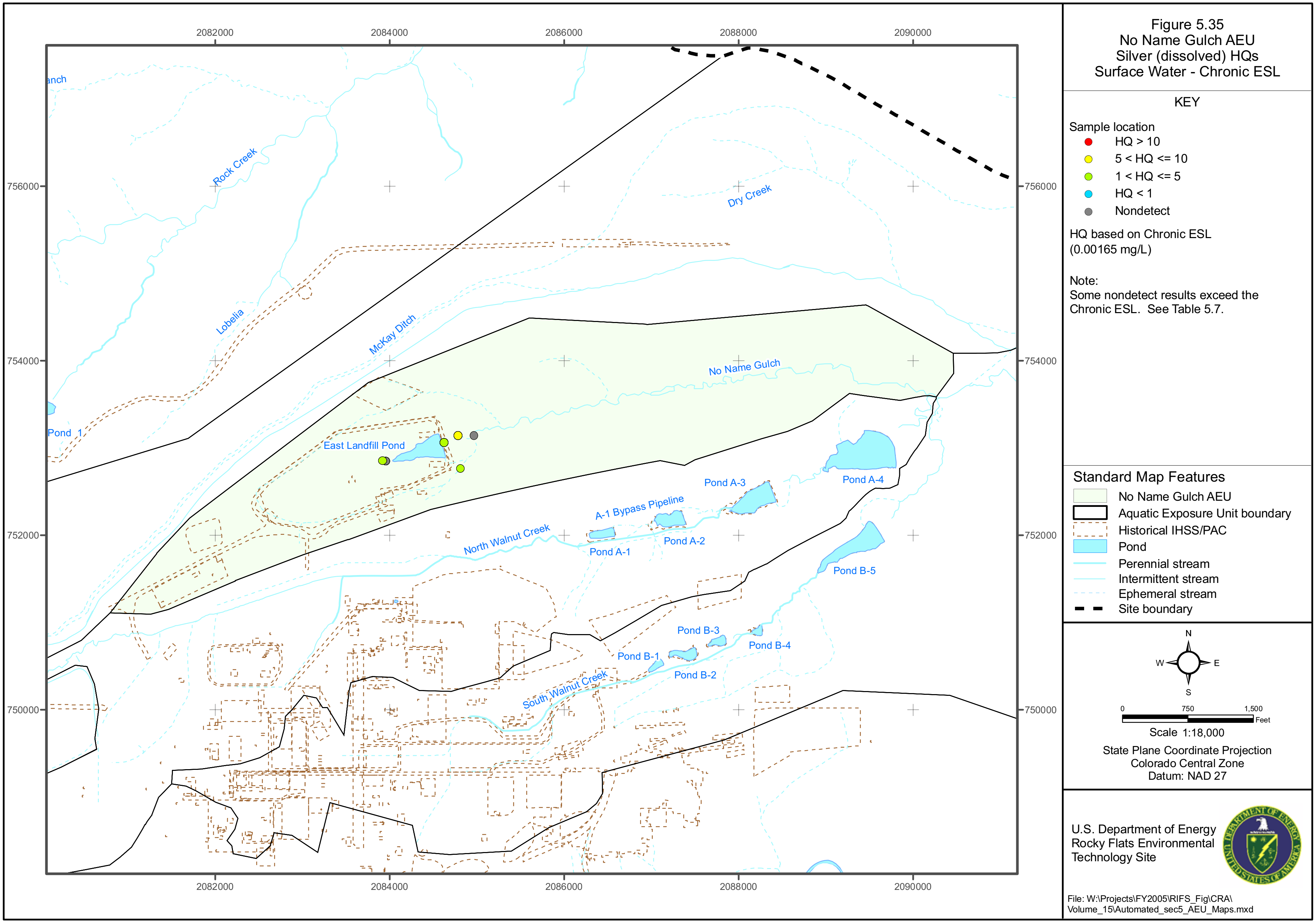


Figure 5.35
No Name Gulch AEU
Silver (dissolved) HQs
Surface Water - Chronic ESL
KEY
Sample location
HQ > 10
5 < HQ <= 10
1 < HQ <= 5
HQ < 1
Nondetect
HQ based on Chronic ESL
(0.00165 mg/L)
Note:
Some nondetect results exceed the
Chronic ESL. See Table 5.7.
Standard Map Features
No Name Gulch AEU
Aquatic Exposure Unit boundary
Historical IHSS/PAC
Pond
Perennial stream
Intermittent stream
Ephemeral stream
Site boundary
N
W
E
S
0
750
1,500
Feet
Scale 1:18,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27
U.S. Department of Energy
Rocky Flats Environmental
Technology Site
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2082000
2084000
2086000
2088000
2090000
756000
754000
752000
750000
anch
Rock Creek
Dry Creek
Lobelia
McKay Ditch
No Name Gulch
Pond 1
East Landfill Pond
Pond A-3
Pond A-4
A-1 Bypass Pipeline
North Walnut Creek
Pond A-1
Pond A-2
Pond B-5
Pond B-3
Pond B-4
Pond B-1
Pond B-2
South Walnut Creek

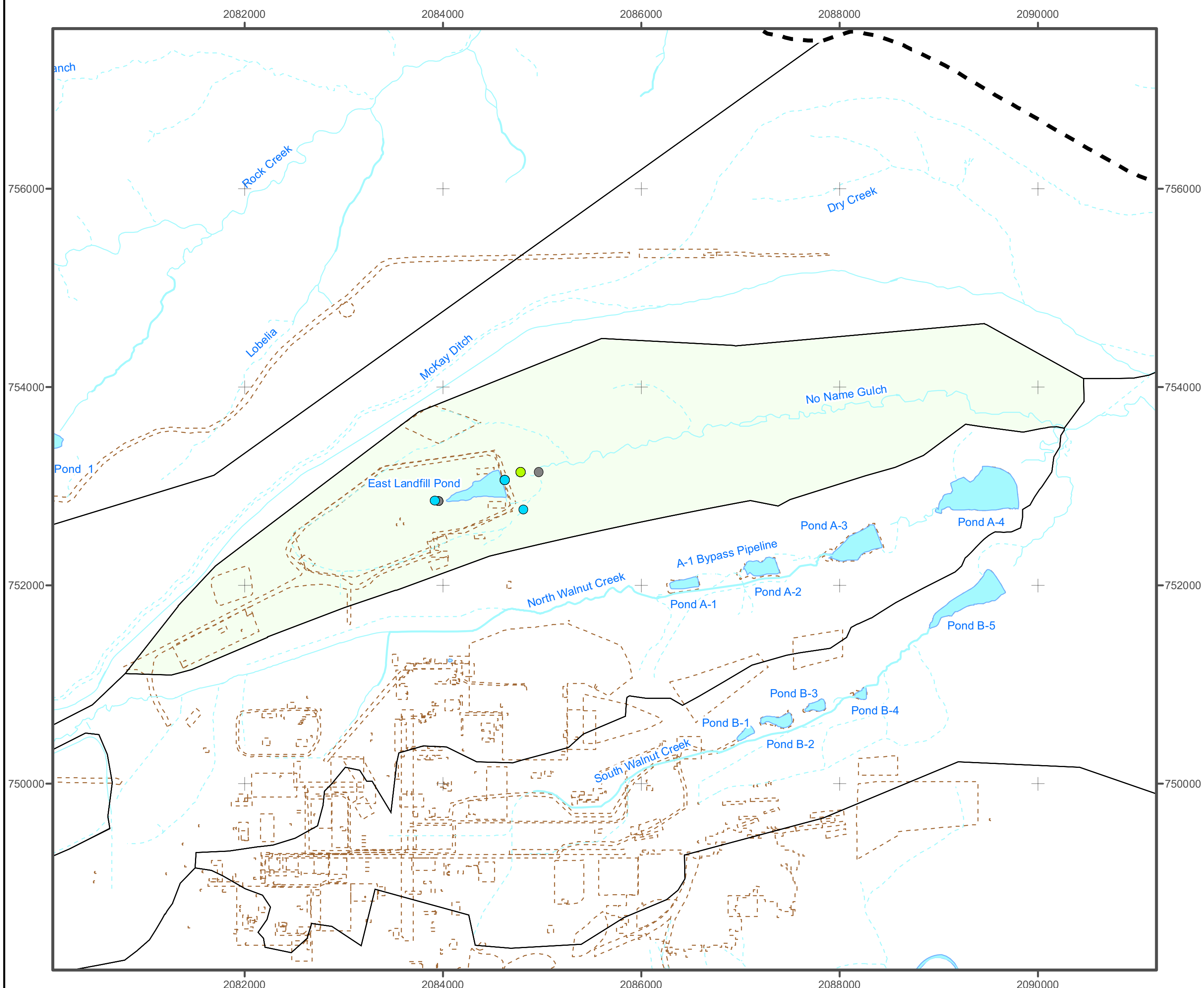

Figure 5.36
No Name Gulch AEU
Silver (dissolved) HQs
Surface Water - Acute Criterion

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on Acute AWQC (0.0104 mg/L)

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 750 1,500 Feet

Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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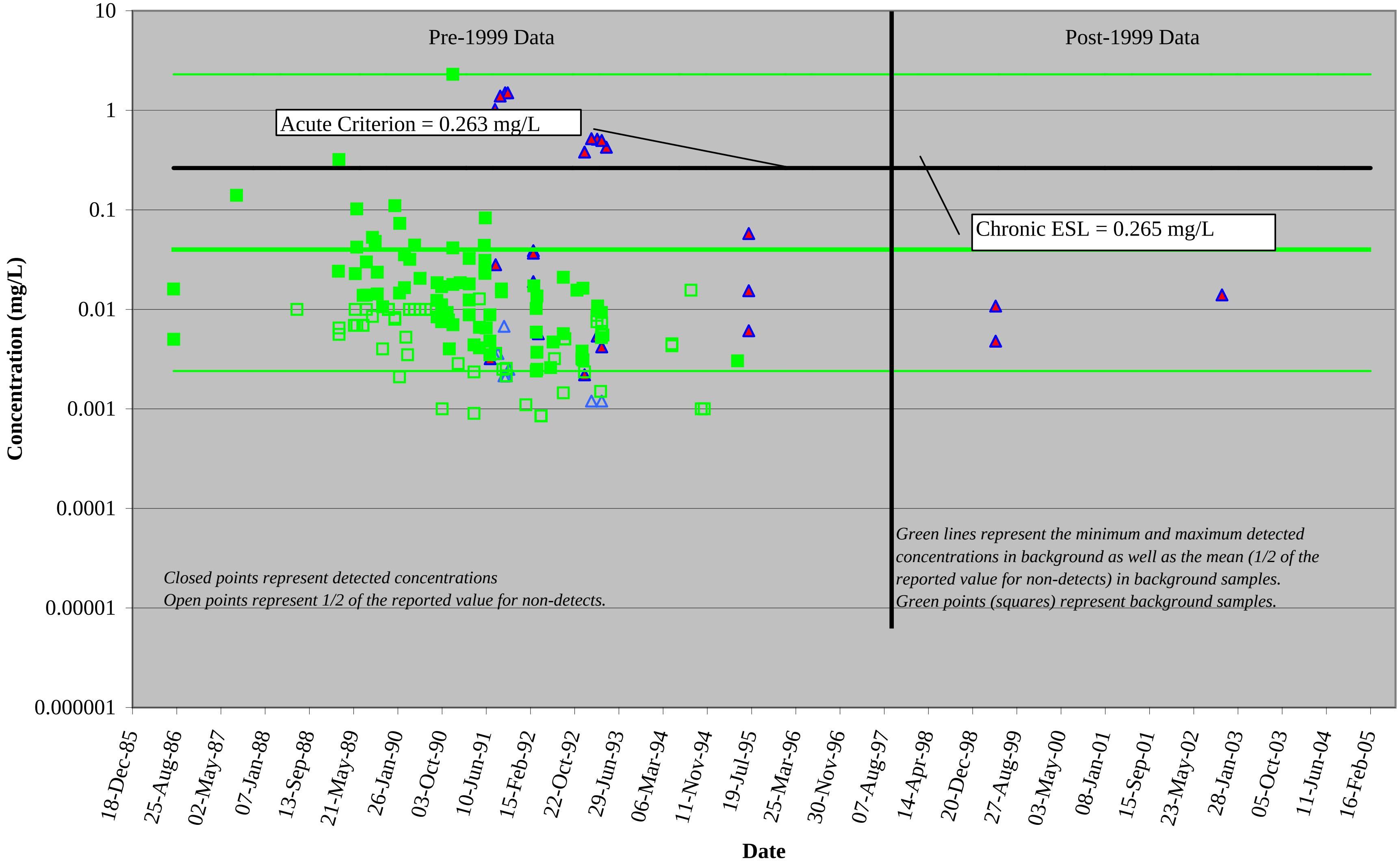
Figure 5.37
Temporal Trends in Surface Water Zinc (Dissolved) Concentrations
No Name Gulch Drainage AEU



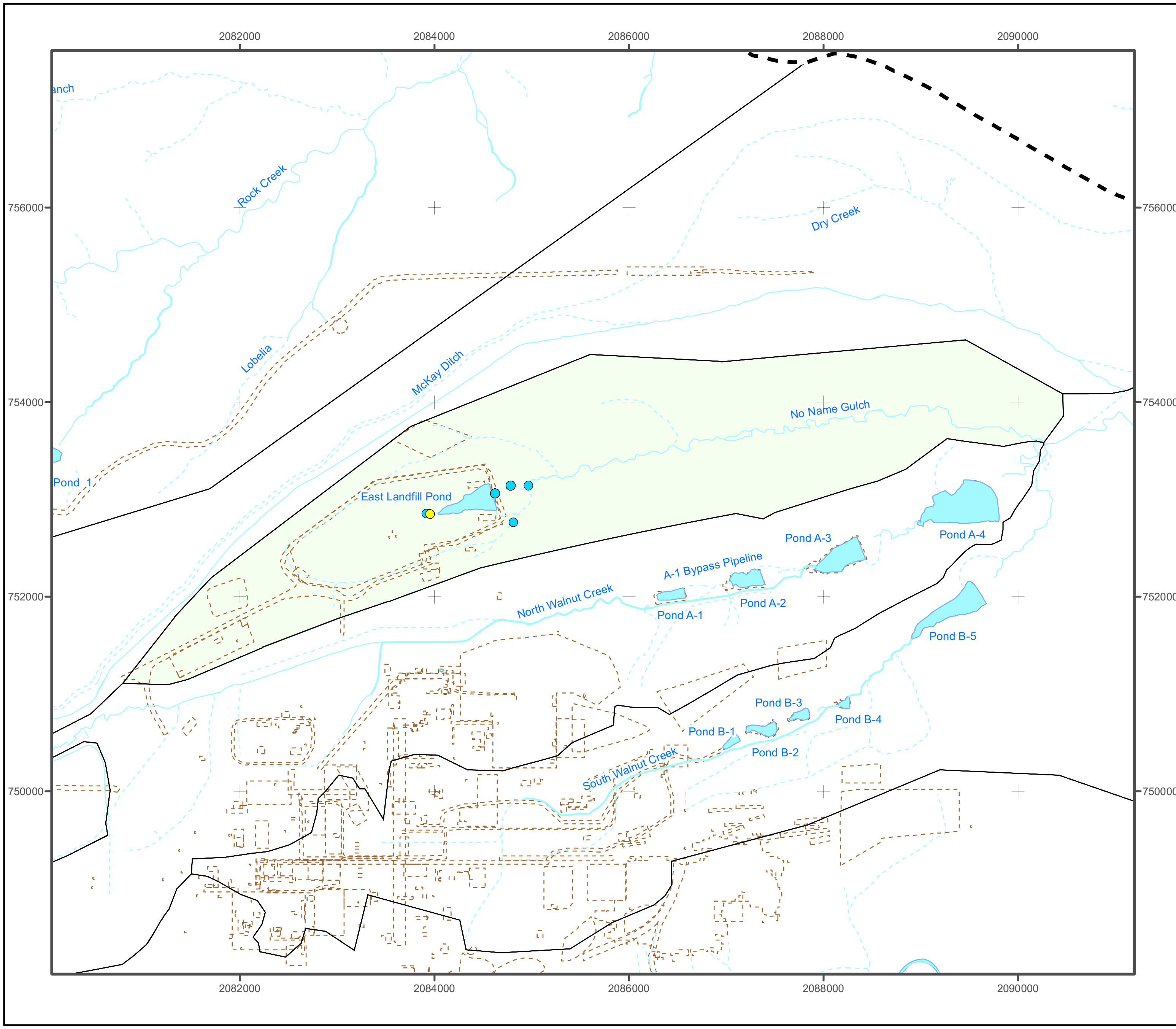


Figure 5.38
No Name Gulch AEU
Zinc (dissolved) HQs
Surface Water - Chronic ESL

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on Chronic ESL
(0.265 mg/L)

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 750 1,500 Feet

Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Rocky Flats Environmental
Technology Site

File: W:\Projects\FY2005\RIFS_Fig\CRA\
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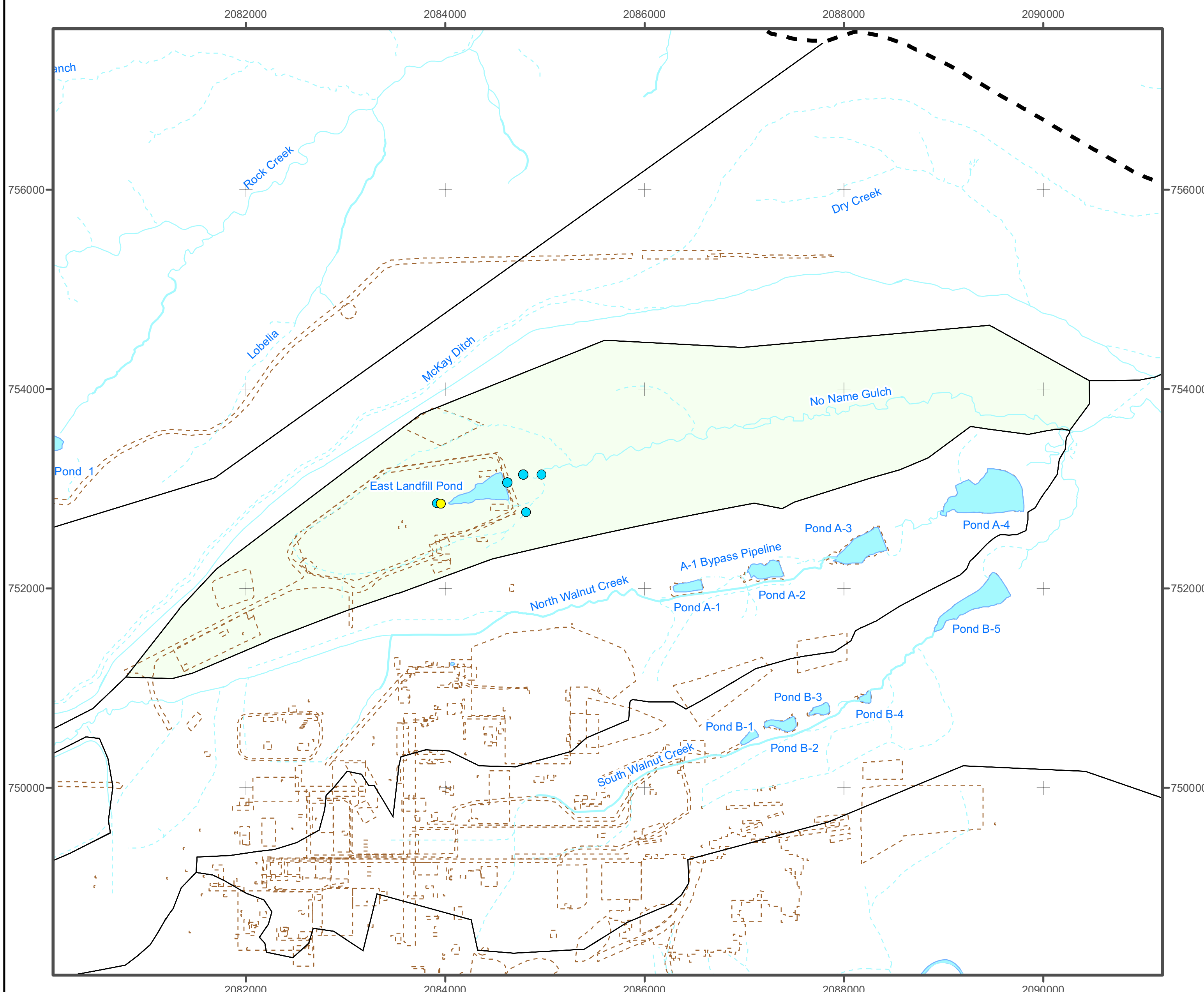

Figure 5.39
No Name Gulch AEU
Zinc (dissolved) HQs
Surface Water - Acute Criterion

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on Acute AWQC (0.262 mg/L)

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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0 750 1,500 Feet
Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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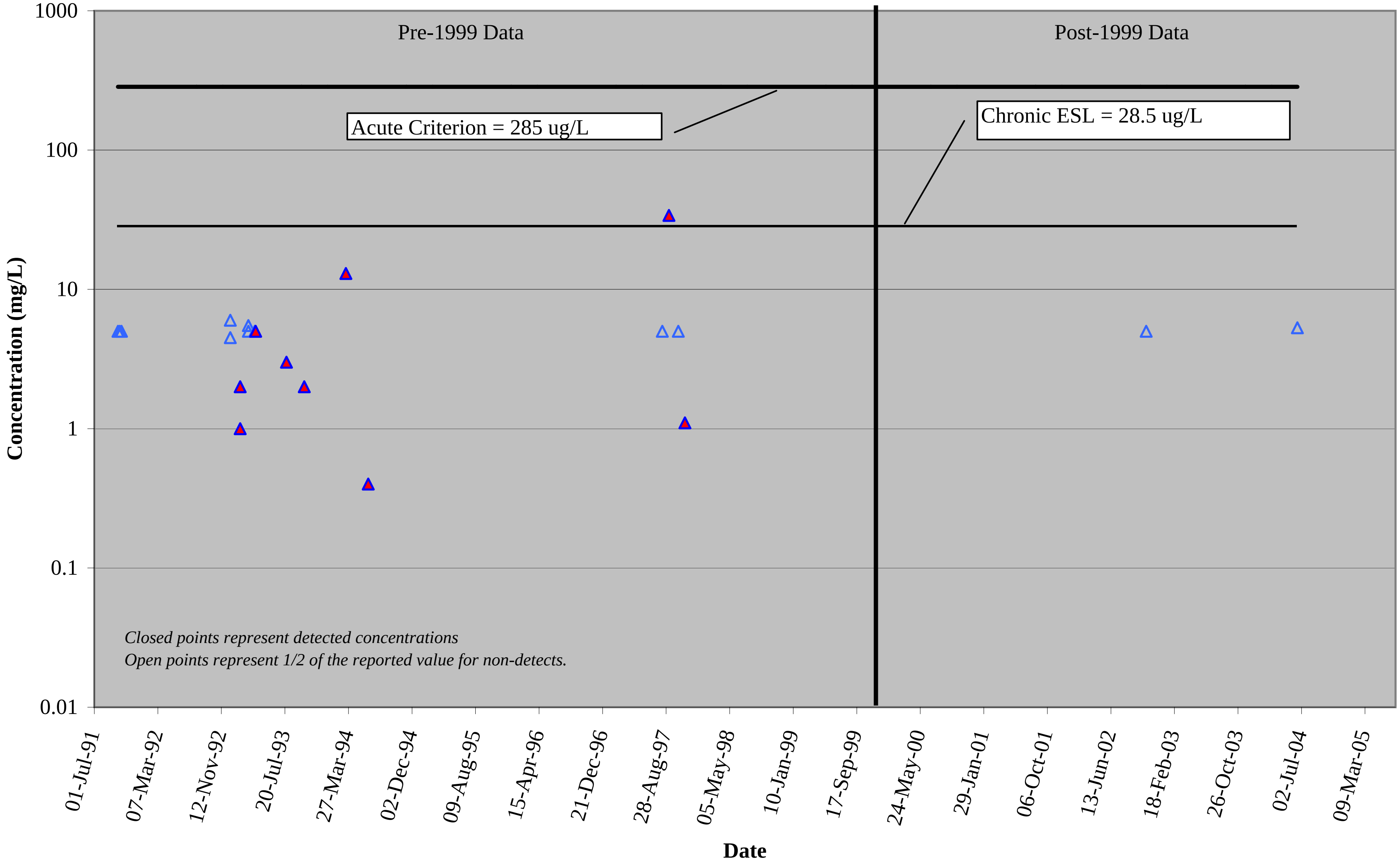
Figure 5.40
Temporal Trends in Surface Water Bis(2-ethylhexyl)phthalate Concentrations
No Name Gulch Drainage AEU



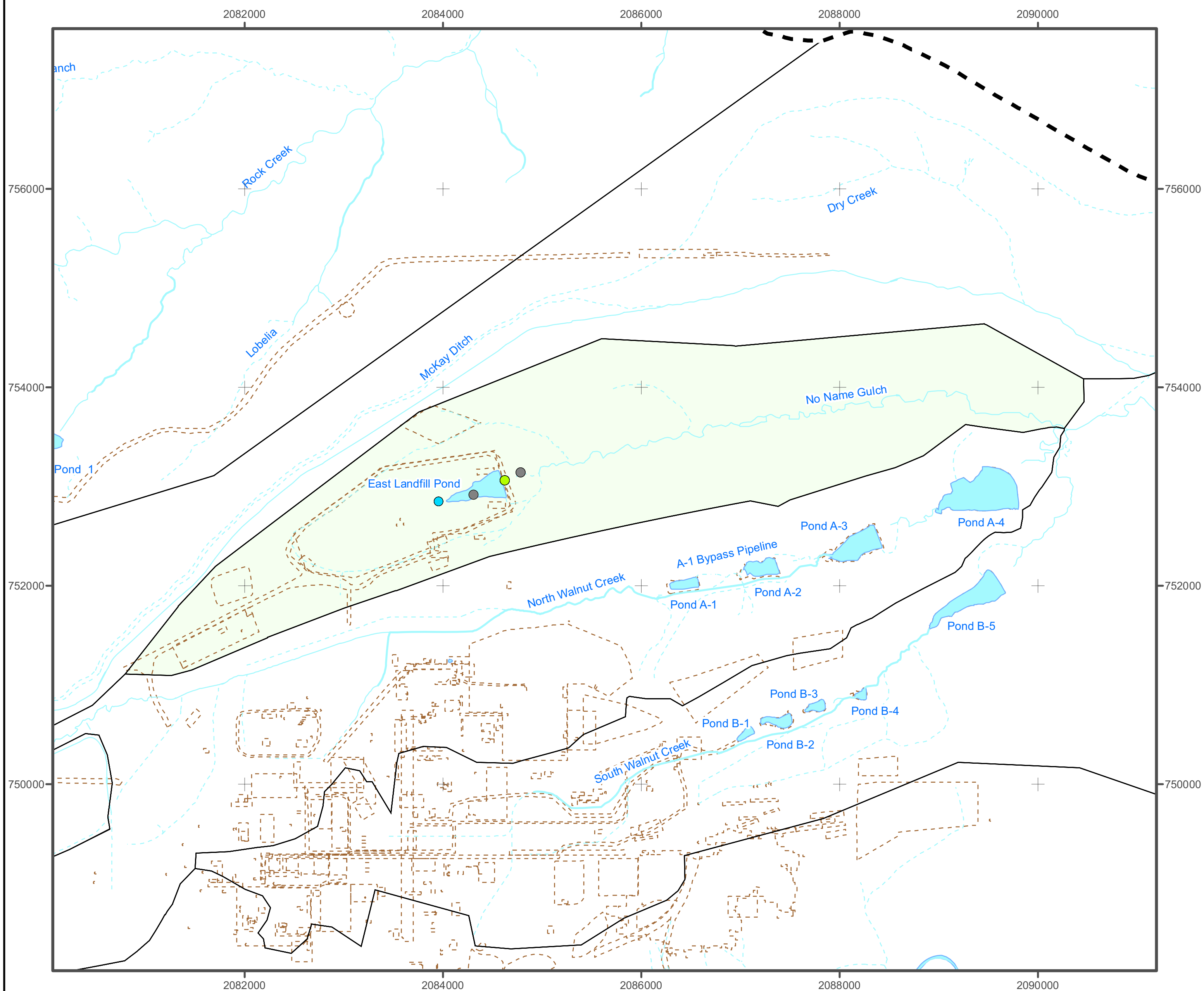


Figure 5.41
No Name Gulch AEU
Bis(2-ethylhexyl)phthalate HQs
Surface Water - Chronic ESL

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on Chronic ESL
(28.5 ug/L)

Note:
No Acute Criterion HQs >1,
so no figure provided.

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 750 1,500 Feet

Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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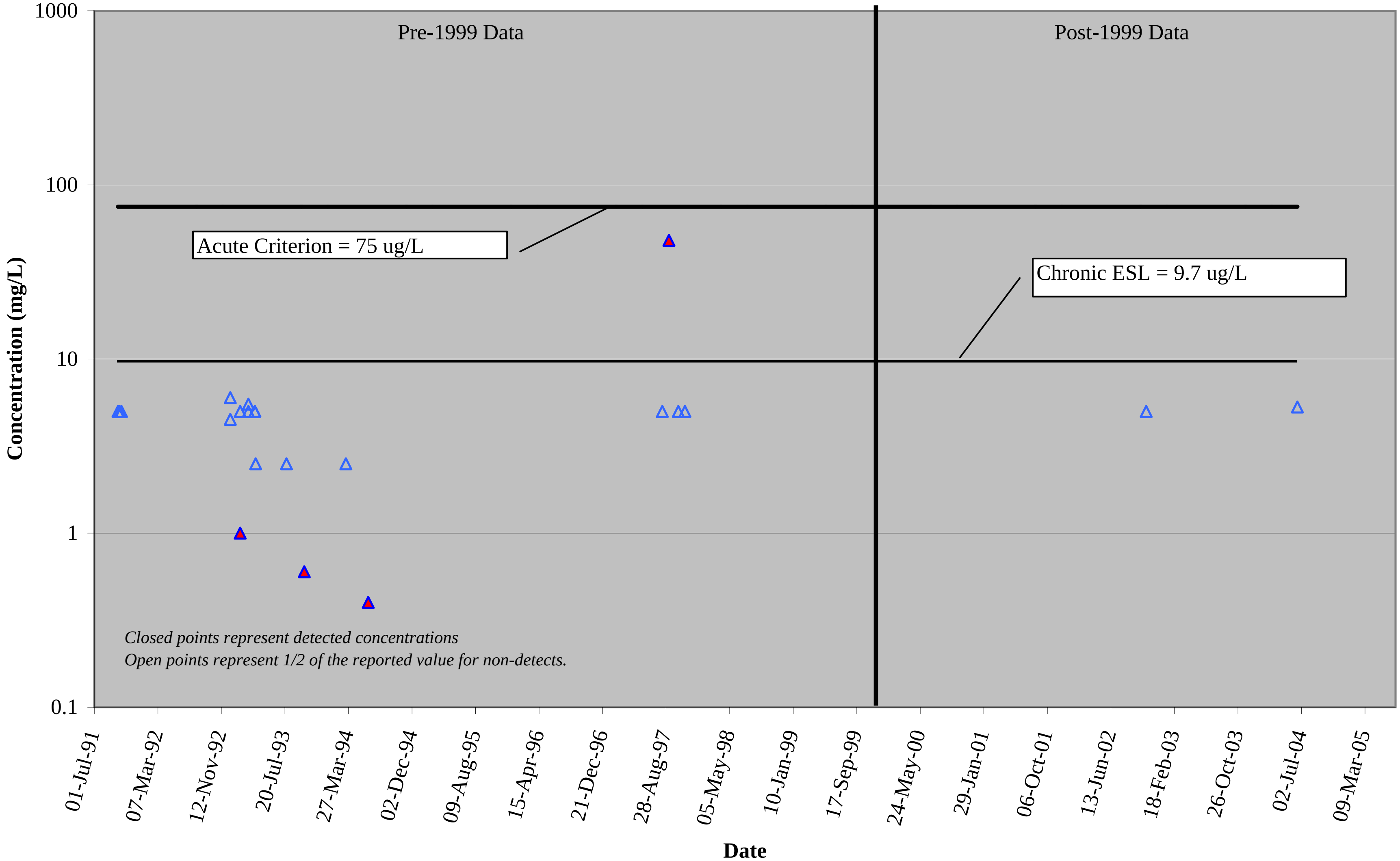
File: W:\Projects\FY2005\RIFS_Fig\CRA\
Volume_15\Automated_sec5_AEU_Maps.mxd

Figure 5.42
Temporal Trends in Surface Water Di-n-butylphthalate Concentrations
No Name Gulch Drainage AEU



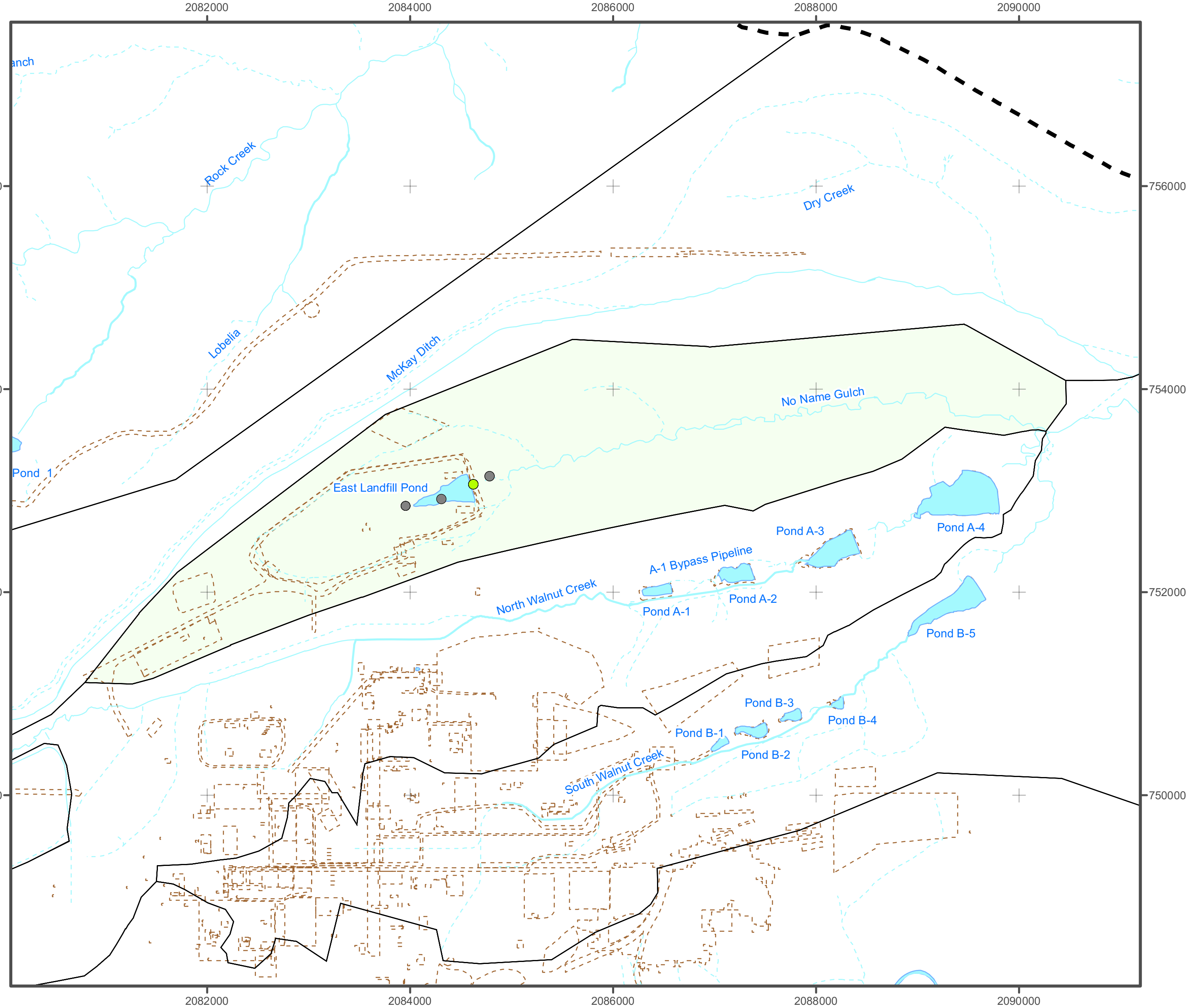


Figure 5.43
No Name Gulch AEU
Di-n-butylphthalate HQs
Surface Water - Chronic ESL

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on Chronic ESL
(9.7 ug/L)

Note:
No Acute Criterion HQs >1,
so no figure provided.

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 750 1,500 Feet

Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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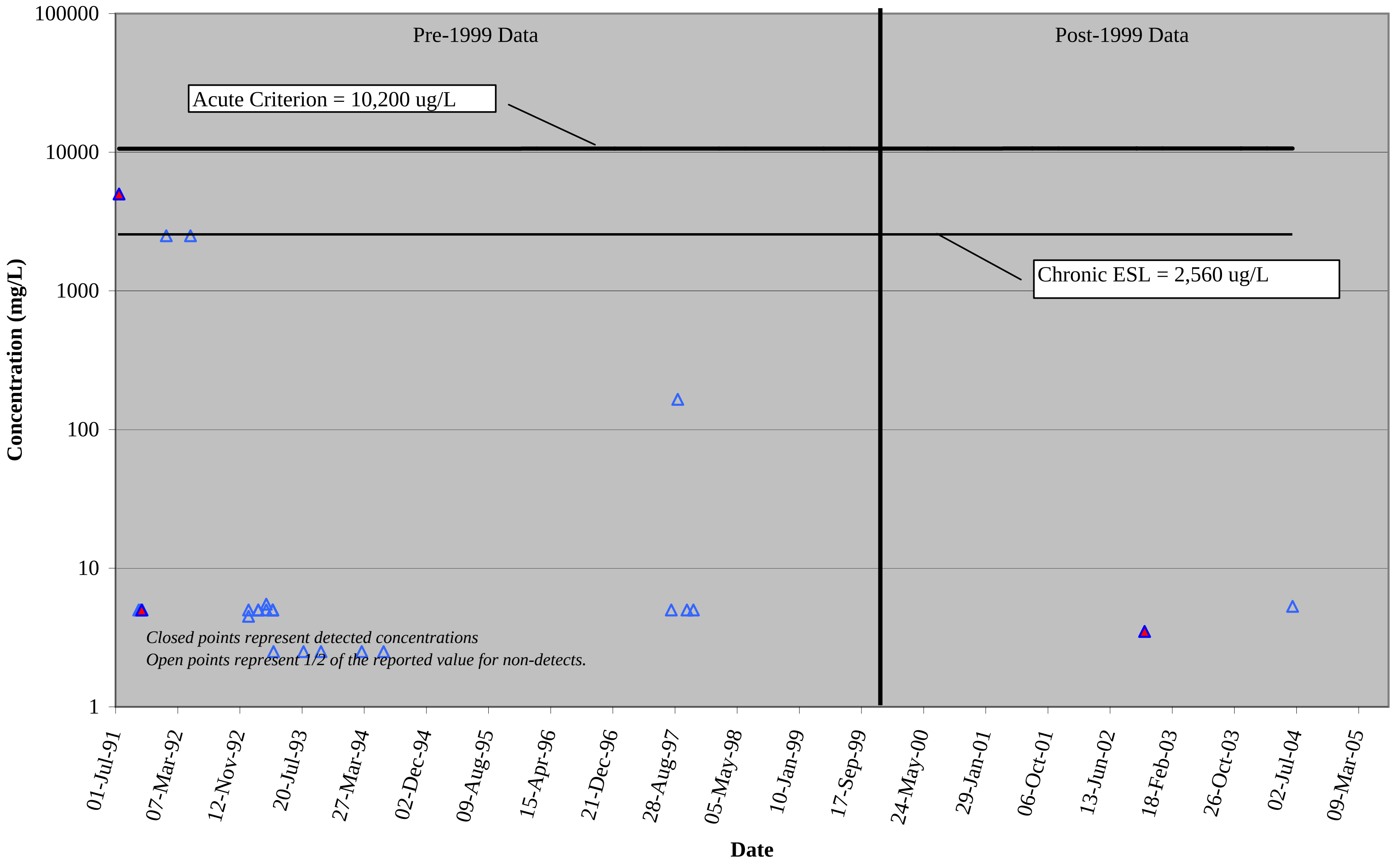
Figure 5.44
Temporal Trends in Surface Water Phenol Concentrations
No Name Gulch Drainage AEU



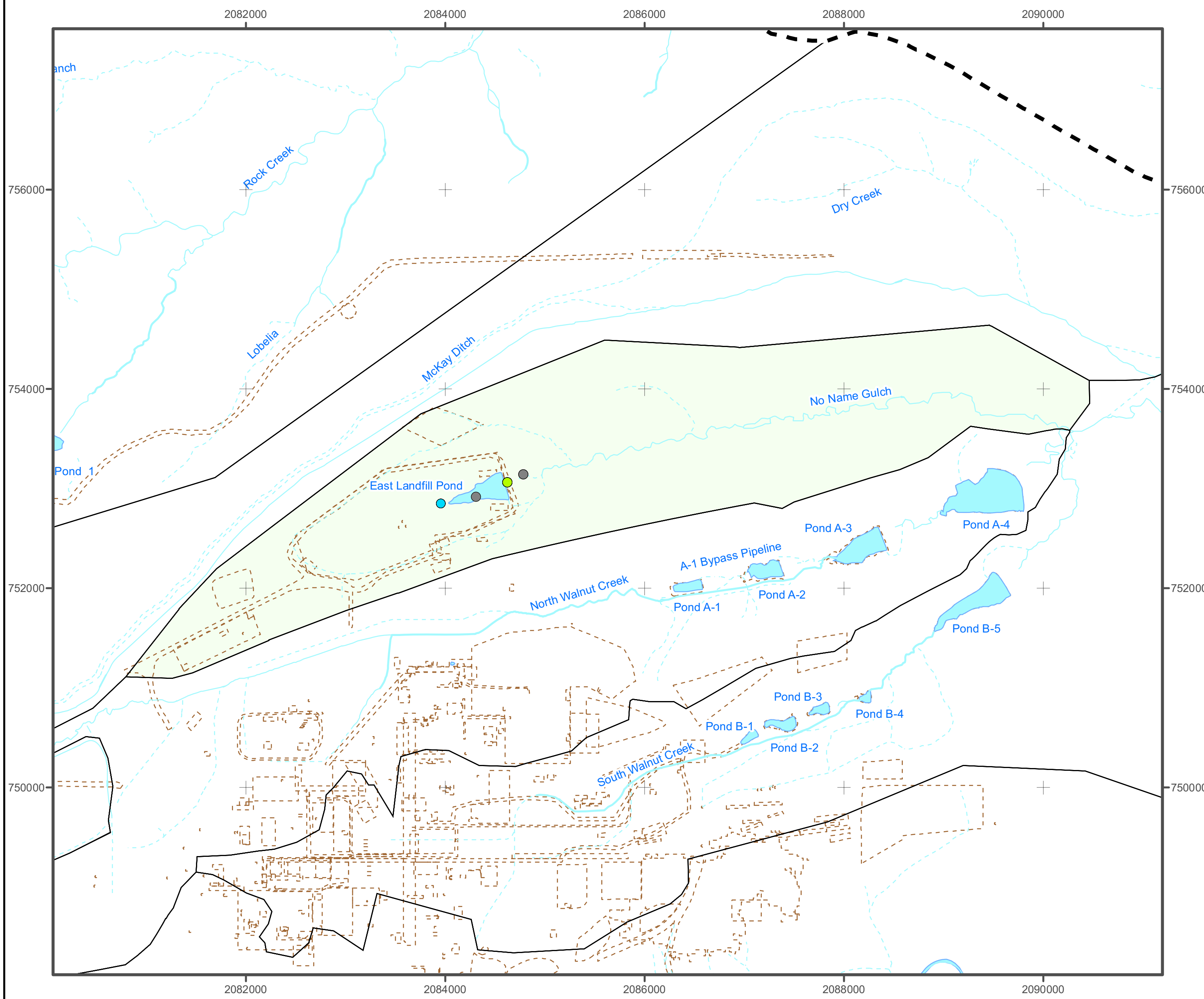


Figure 5.45
No Name Gulch AEU
Phenol HQs
Surface Water - Chronic ESL

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on Chronic ESL
(2560 ug/L)

Note:
No Acute Criterion HQs >1,
so no figure provided.

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 750 1,500 Feet

Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
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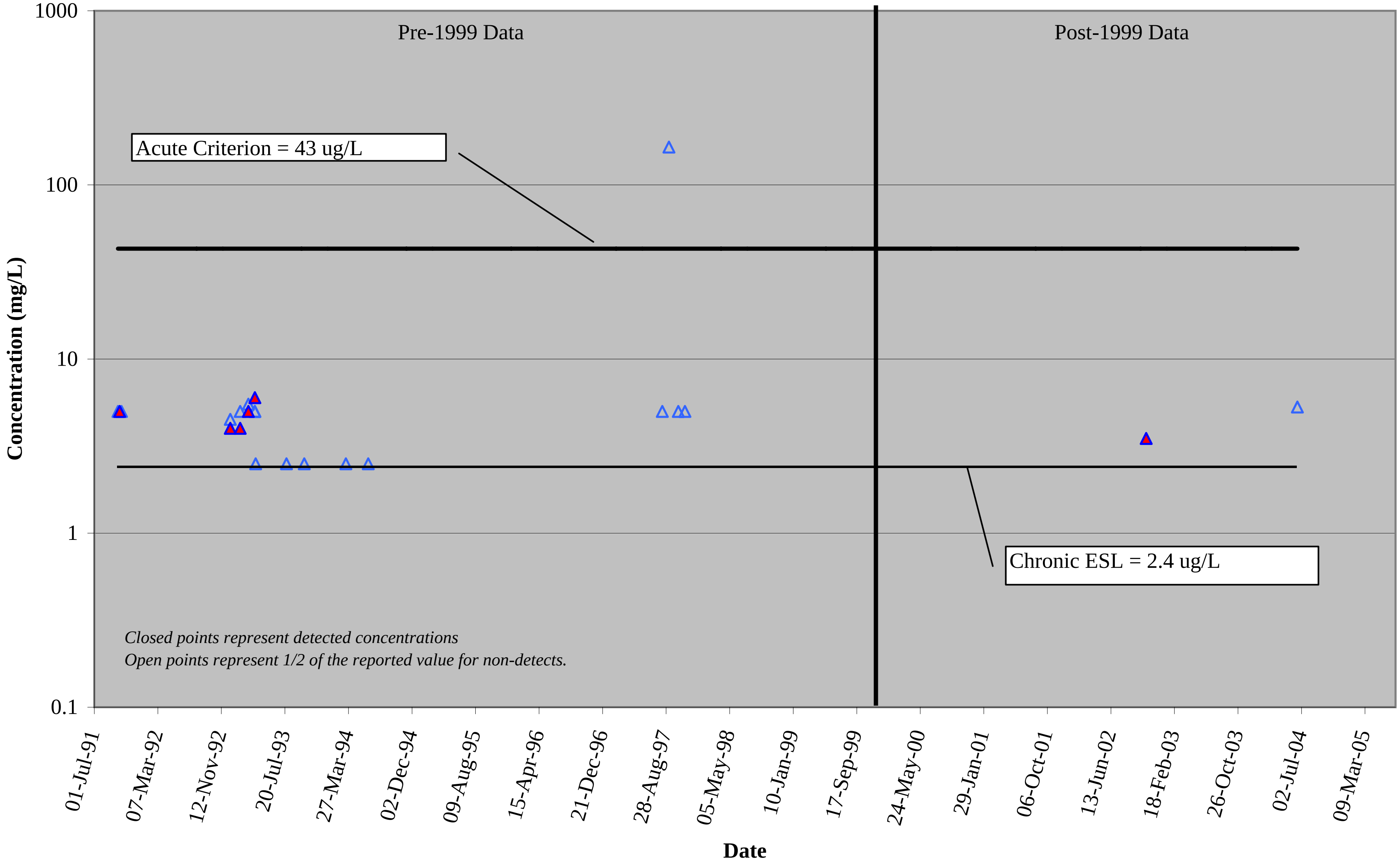
File: W:\Projects\FY2005\RIFS_Fig\CRA\Volume_15\Automated_sec5_AEU_Maps.mxd

Figure 5.46
Temporal Trends in Surface Water Phenanthrene Concentrations
No Name Gulch Drainage AEU



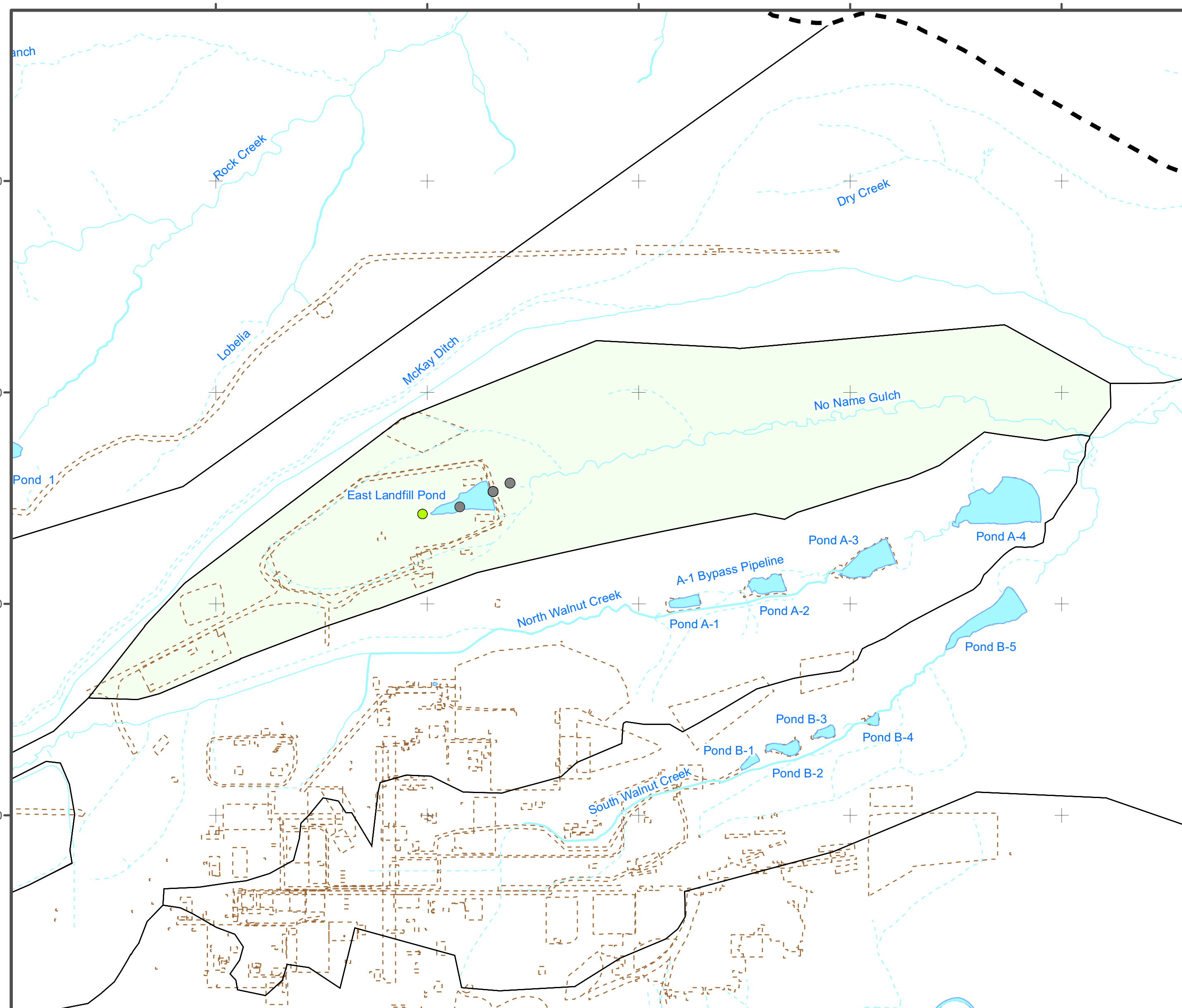


Figure 5.47
No Name Gulch AEU
Phenanthrene HQs
Surface Water - Chronic ESL

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on Chronic ESL
(2.4 ug/L)

Note:
Some nondetect results exceed the Chronic ESL. See Table 5.7.

No Acute Criterion HQs >1, so no figure provided.

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 750 1,500 Feet
Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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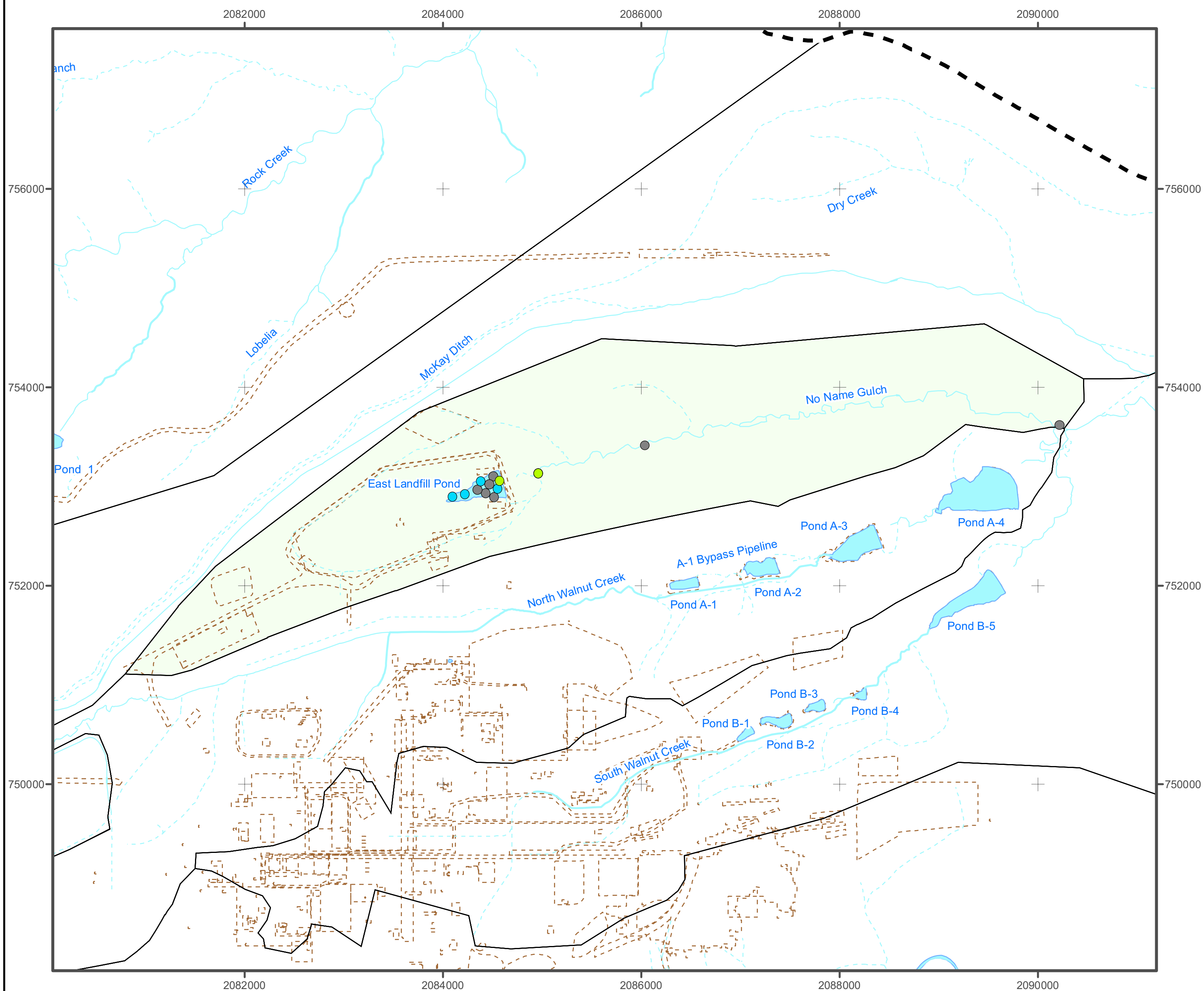
File: W:\Projects\FY2005\RIFS_Fig\CRA\Volume_15\Automated_sec5_AEU_Maps.mxd

Figure 5.48
No Name Gulch AEU
Benzo(a)anthracene HQs
Sediment - NOEC ESL



KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on NOEC ESL
(108 ug/kg)

Note:
Some nondetect results exceed the NOEC ESL. See Table 5.9.

No LOEC HQs >1, so no LOEC figure provided.

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 750 1,500
Feet

Scale 1:18,000

State Plane Coordinate Projection
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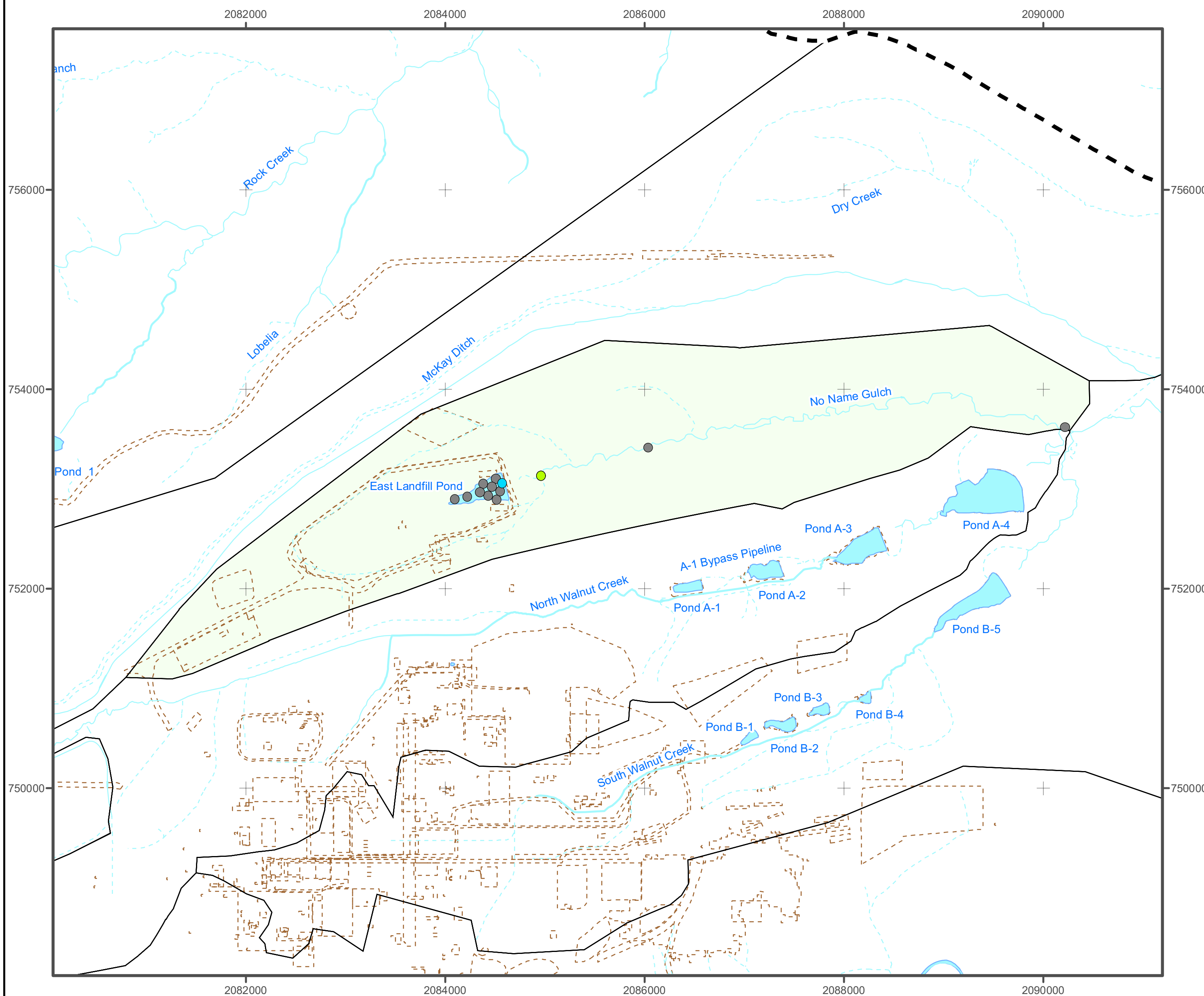
File: W:\Projects\FY2005\RIFS_Fig\CRA\Volume_15\Automated_sec5_AEU_Maps.mxd

Figure 5.49
No Name Gulch AEU
Benzo(a)pyrene HQs
Sediment - NOEC ESL



KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on NOEC ESL
(150 ug/kg)

Note:
Some nondetect results exceed the NOEC ESL. See Table 5.9.

No LOEC HQs >1, so no LOEC figure provided.

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W
E
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0 750 1,500 Feet

Scale 1:18,000

State Plane Coordinate Projection
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Volume_15\Automated_sec5_AEU_Maps.mxd

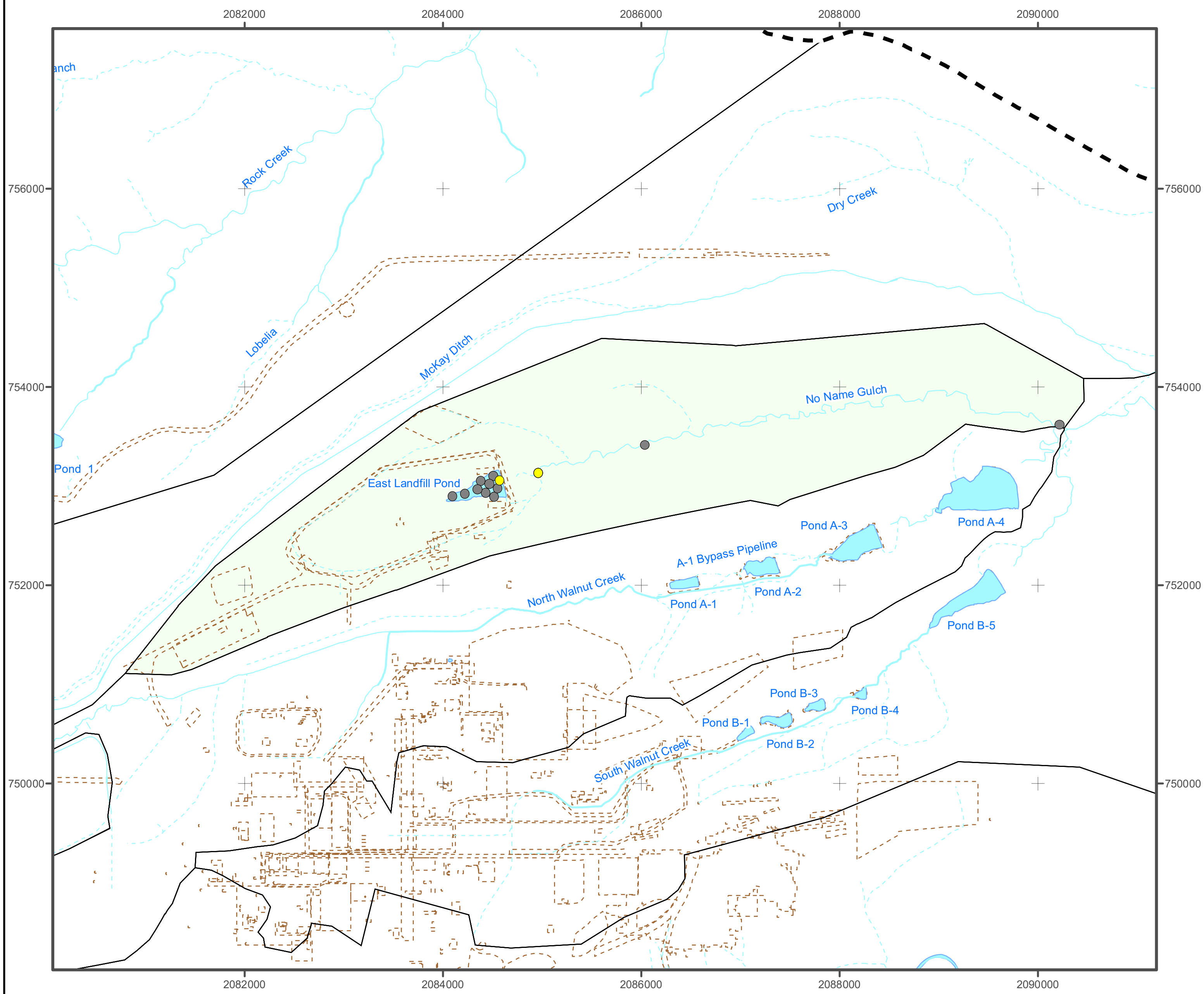

Figure 5.50
No Name Gulch AEU
Benzo(g,h,i)perylene HQs
Sediment - NOEC ESL

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on NOEC ESL
(13 ug/kg)

Note:
Some nondetect results exceed the NOEC ESL. See Table 5.9.

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 750 1,500
Feet

Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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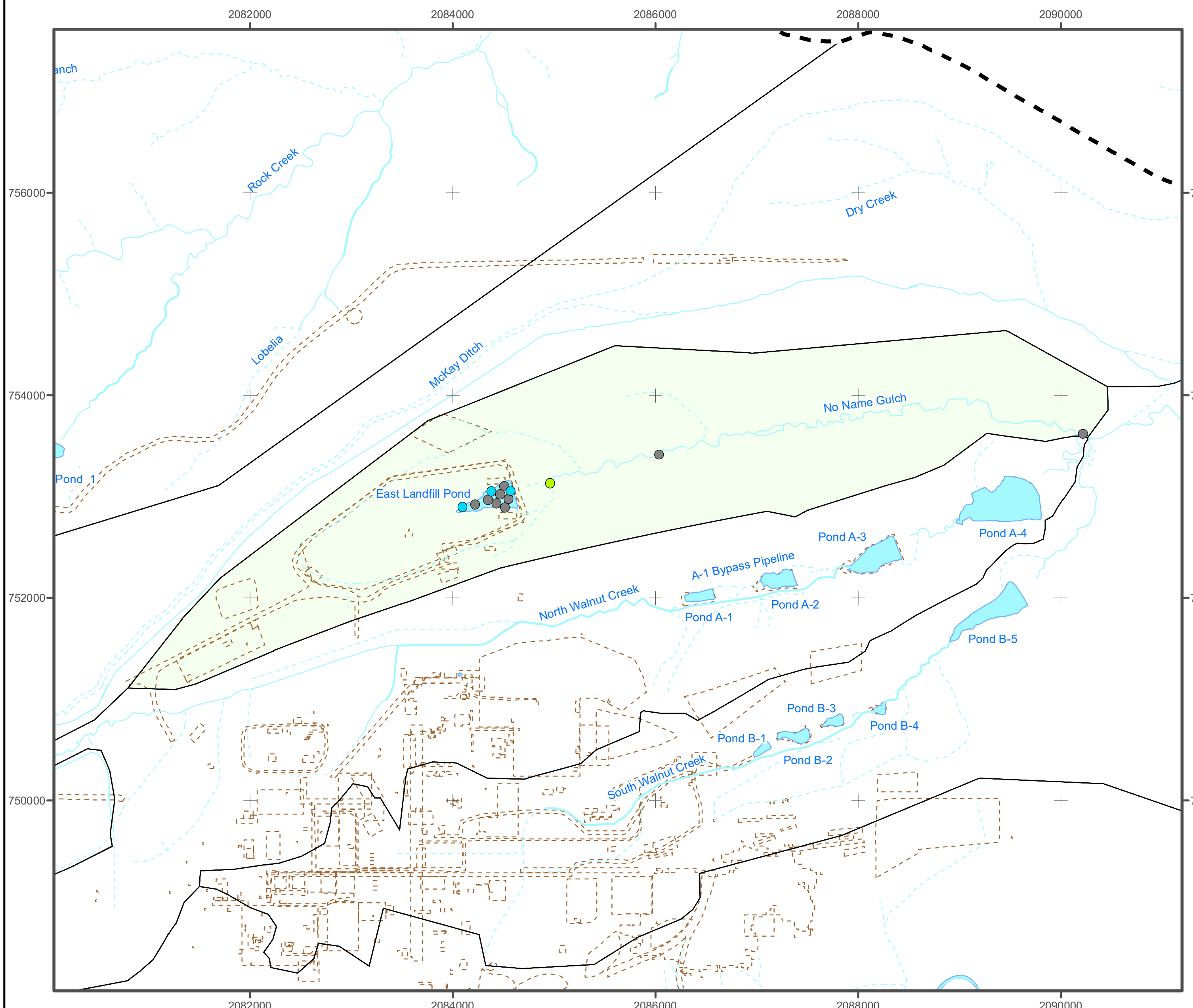

Figure 5.51
No Name Gulch AEU
Chrysene HQs
Sediment - NOEC ESL

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on NOEC ESL
(166 ug/kg)

Note:
Some nondetect results exceed the NOEC ESL. See Table 5.9.

No LOEC HQs >1, so no LOEC figure provided.

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 750 1,500 Feet

Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
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File: W:\Projects\FY2005\RIFS_Fig\CRA\Volume_15\Automated_sec5_AEU_Maps.mxd

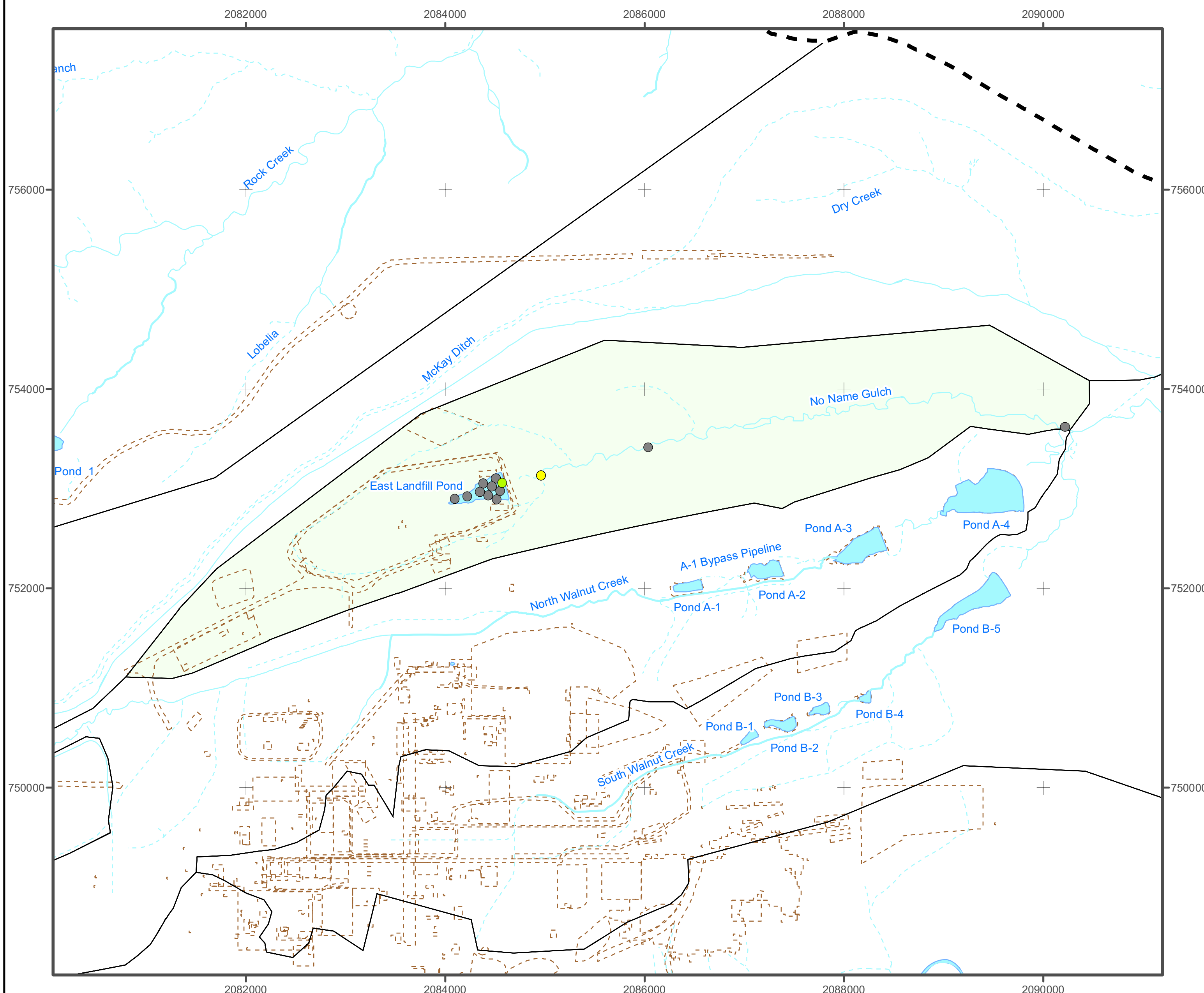

Figure 5.52
No Name Gulch AEU
Indeno(1,2,3-cd)pyrene HQs
Sediment - NOEC ESL

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on NOEC ESL
(17 ug/kg)

Note:
Some nondetect results exceed the NOEC ESL. See Table 5.9.

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 750 1,500
Feet

Scale 1:18,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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File: W:\Projects\FY2005\RIFS_Fig\CRA\Volume_15\Automated_sec5_AEU_Maps.mxd

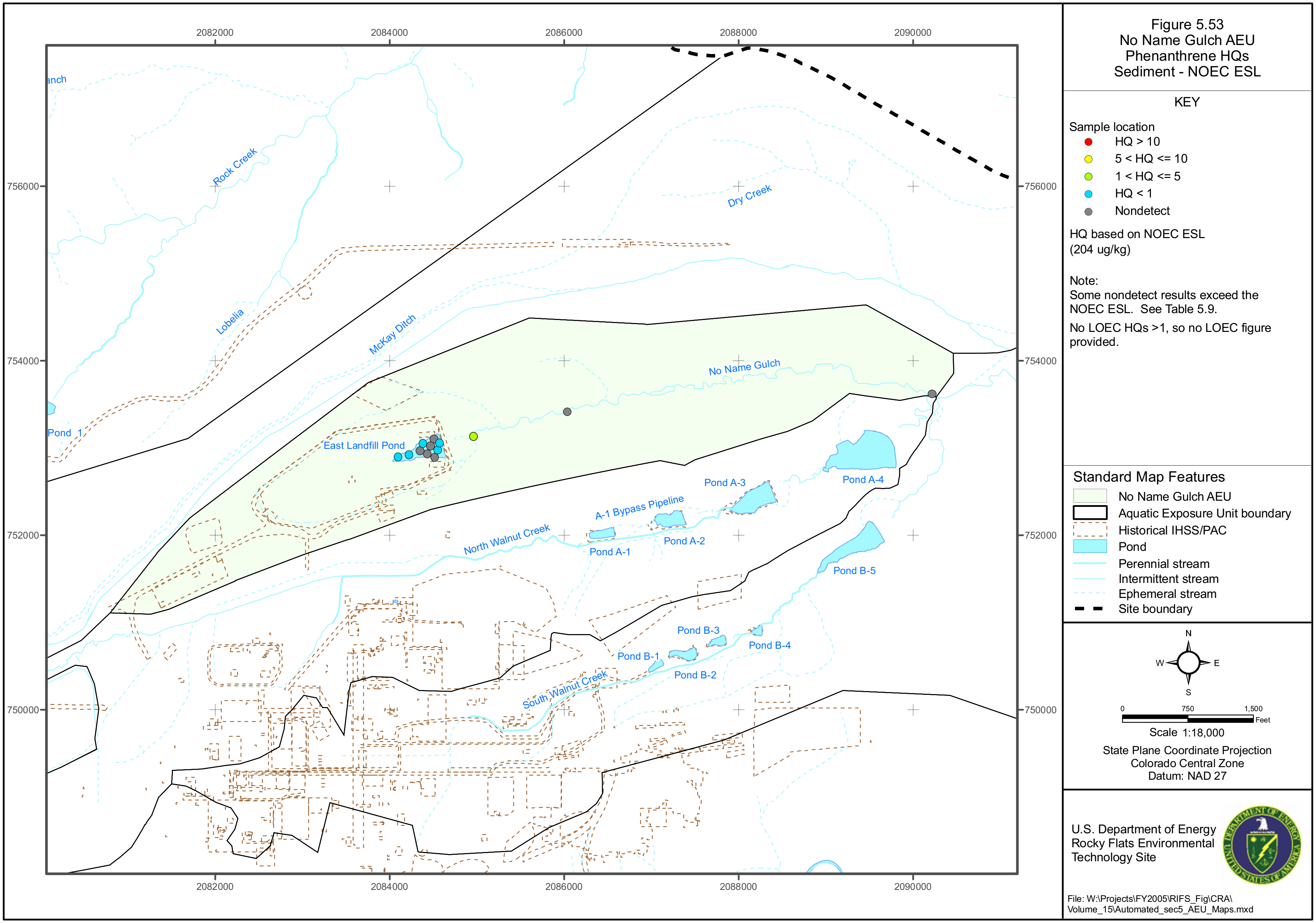

Figure 5.53
No Name Gulch AEU
Phenanthrene HQs
Sediment - NOEC ESL
KEY
Sample location
HQ > 10
5 < HQ <= 10
1 < HQ <= 5
HQ < 1
Nondetect
HQ based on NOEC ESL
(204 ug/kg)
Note:
Some nondetect results exceed the NOEC ESL. See Table 5.9.
No LOEC HQs >1, so no LOEC figure provided.
Standard Map Features
No Name Gulch AEU
Aquatic Exposure Unit boundary
Historical IHSS/PAC
Pond
Perennial stream
Intermittent stream
Ephemeral stream
Site boundary
N
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0
750
1,500
Feet
Scale 1:18,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27
U.S. Department of Energy
Rocky Flats Environmental Technology Site
File: W:\Projects\FY2005\RIFS_Fig\CRA\Volume_15\Automated_sec5_AEU_Maps.mxd
2082000
2084000
2086000
2088000
2090000
756000
754000
752000
750000
Rock Creek
Dry Creek
Lobelia
McKay Ditch
No Name Gulch
Pond 1
East Landfill Pond
Pond A-3
Pond A-4
A-1 Bypass Pipeline
North Walnut Creek
Pond A-1
Pond A-2
Pond B-5
Pond B-3
Pond B-4
Pond B-1
Pond B-2
South Walnut Creek

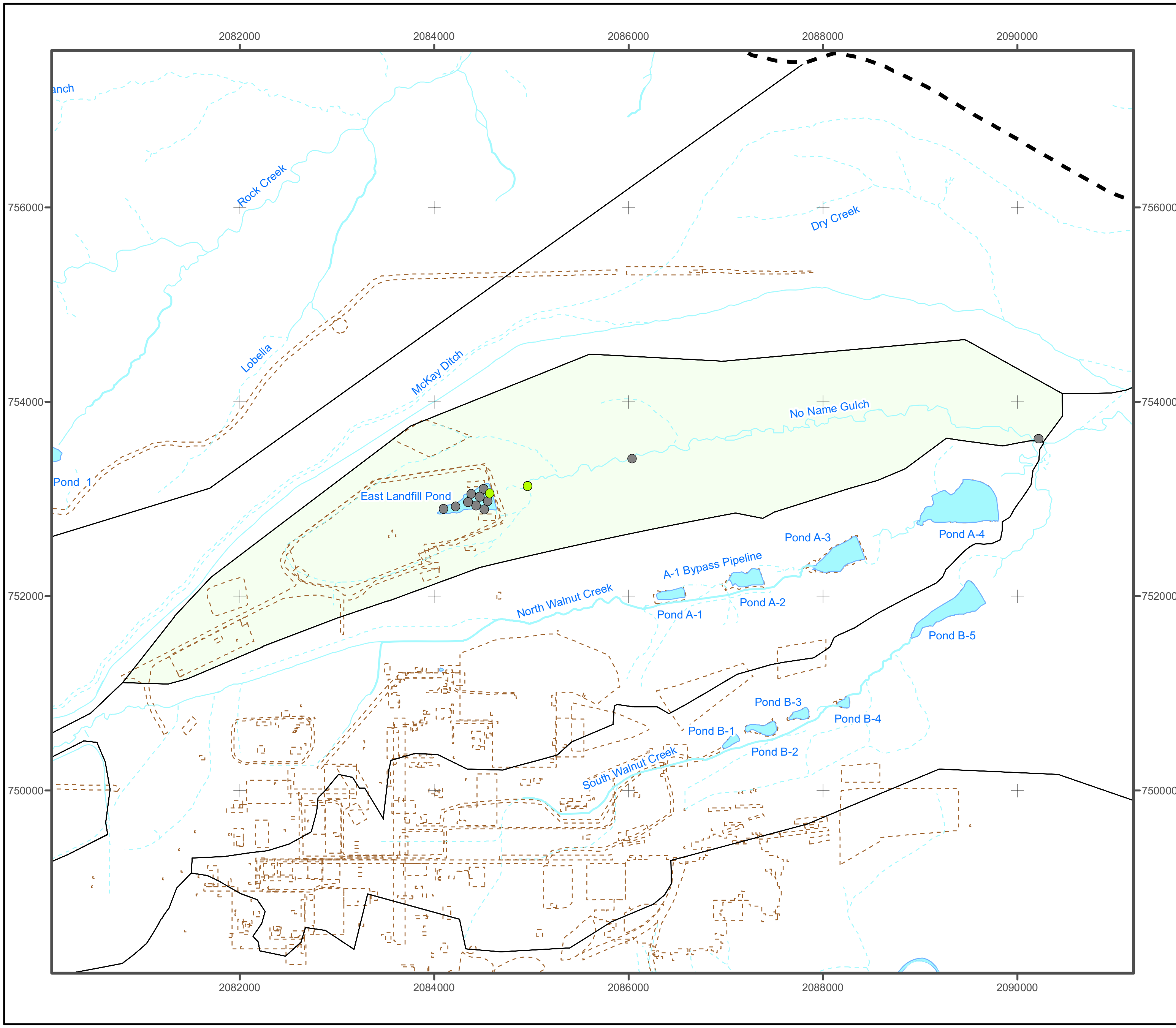

Figure 5.54
No Name Gulch AEU
Pyrene HQs
Sediment - NOEC ESL

KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on NOEC ESL
(195 ug/kg)

Note:
Some nondetect results exceed the NOEC ESL. See Table 5.9.

No LOEC HQs >1, so no LOEC figure provided.

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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0 750 1,500 Feet

Scale 1:18,000

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Rocky Flats Environmental Technology Site

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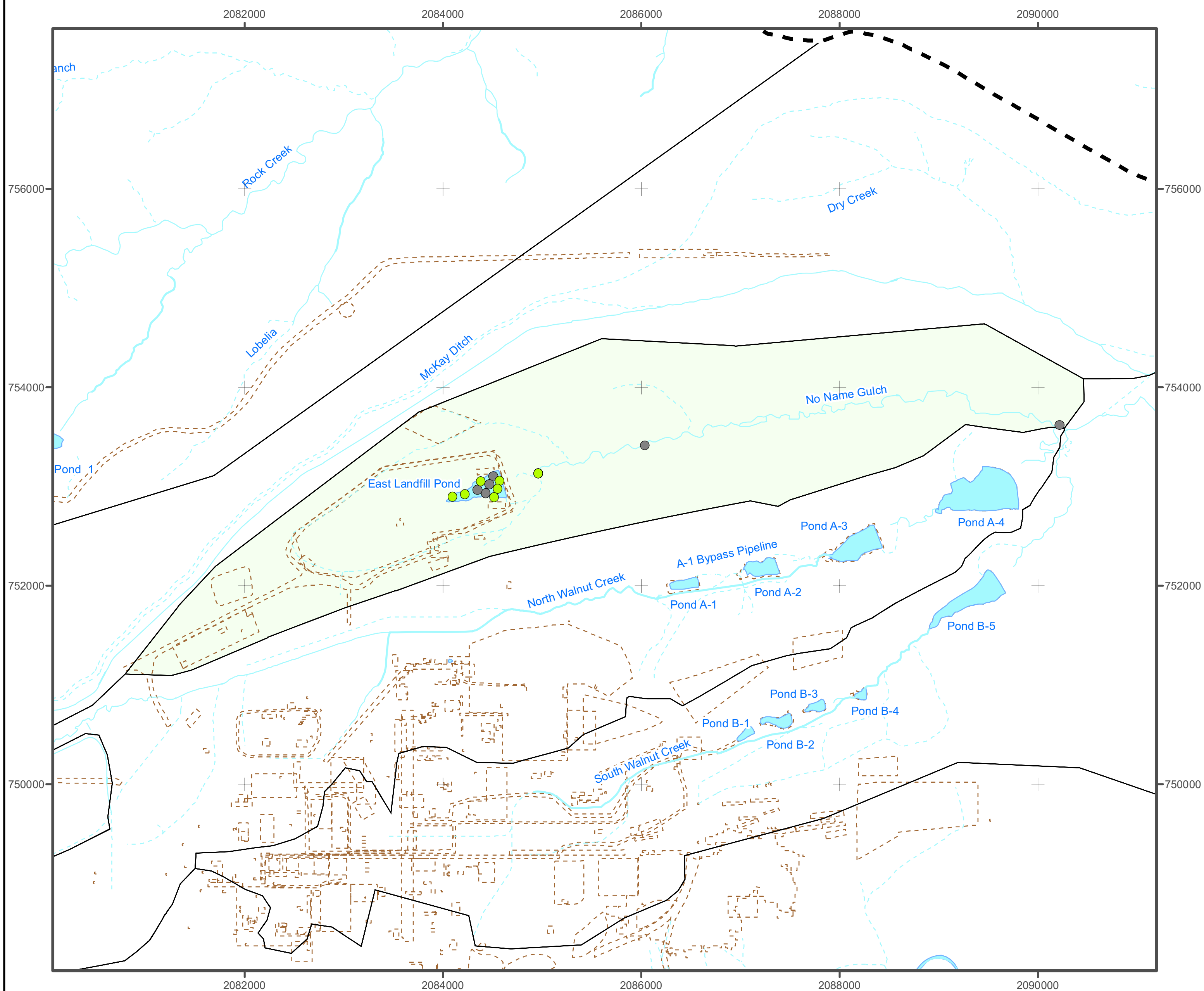
Figure 5.55
No Name Gulch AEU
Total PAHs HQs
Sediment - NOEC ESL



KEY

Sample location
- HQ > 10
- 5 < HQ <= 10
- 1 < HQ <= 5
- HQ < 1
- Nondetect

HQ based on NOEC ESL
(1610 ug/kg)

Note:
Some nondetect results exceed the NOEC ESL. See Table 5.9.

No LOEC HQs >1, so no LOEC figure provided.

Standard Map Features
- No Name Gulch AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N
W E
S

0 750 1,500 Feet

Scale 1:18,000

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<u>COMPREHENSIVE RISK ASSESSMENT</u>

NO NAME GULCH AQUATIC EXPOSURE UNIT, ROCK CREEK AQUATIC EXPOSURE UNIT, MCKAY DITCH AQUATIC EXPOSURE UNIT, SOUTHEAST AQUATIC EXPOSURE UNIT

VOLUME 15B1: ATTACHMENT 1

Detection Limit Screen

TABLE OF CONTENTS

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

µg/kg	micrograms per kilogram
µg/L	micrograms per liter
AEU	Aquatic Exposure Unit
CD	compact disc
CDH	Colorado Department of Health
CLP	Contract Laboratory Program
CRA	Comprehensive Risk Assessment
CRQL	Contract Required Quantitation Limit
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DOE	Department of Energy
ECOI	Ecological Contaminant of Interest
EPA	Environmental Protection Agency
ESL	ecological screening level
EU	Exposure Unit
IAEU	Industrial Area Exposure Unit
IDL	instrument detection limit
IHSS	Individual Hazardous Substance Site
LOAEL	Lowest Observed Adverse Effect Level
MDL	method detection limit
MK AEU	McKay Ditch Aquatic Exposure Unit

NOAEL	no observed adverse effect level
NN AEU	No Name Gulch Aquatic Exposure Unit
PAC	Potential Area of Concern
PCOC	Potential Contaminant of Concern
PRG	preliminary remediation goal
RC AEU	Rock Creek Aquatic Exposure Unit
RL	reporting limit
SE AEU	Southeast Aquatic Exposure Unit
SQL	sample quantitation limit
SVOC	Semi-volatile organic compound
SWD	soil water database
TCDD	2,3,7,8-tetrachlorodibenzo-*p*-dioxin
WRW	wildlife refuge worker

1.0 EVALUATION OF ANALYTE DETECTION LIMITS FOR THE AQUATIC EXPOSURE UNITS

For the No Name Gulch Aquatic Exposure Unit (AEU), Rock Creek AEU, McKay Ditch AEU, and Southeast AEU, the detection limits for non-detected analytes as well as analytes detected in less than 5 percent of the samples are compared to the ecological screening levels (ESLs). The comparisons are presented in the tables to this attachment for ecological contaminants of interest (ECOIs) in surface water and sediment. The percent of the samples with detection limits that exceed the ESLs are listed in these tables. When these detection limits exceed the respective ESLs with high frequency and magnitude, this is a source of uncertainty in the overall risk estimates, i.e., risks may be underestimated because the analytes may have been included as ECOPCs had the analytes been detected using lower detection limits. This condition requires further analysis using professional judgment and ecological risk potential to determine the extent of this uncertainty.

For surface water, professional judgment indicates whether the analytes have potential to be ECOPCs in the AEU based on 1) a listing of the analytes (or classes of analytes) as constituents in wastes potentially released at historical Individual Hazardous Substance Sites (IHSSs) in the AEU (DOE 2005a), 2) the historical inventory for the analyte at RFETS (CDH 1991), 3) the maximum detected concentration and detection frequency of the analyte in AEU and sitewide surface water, and 4) the maximum detected concentration and detection frequency in AEU surface soil and sediment. The comparison of the AEU and sitewide maximum detected concentrations and detection frequencies (criterion 3) is performed to assess if the AEU observations are much higher, which may indicate a potential historical source for the analyte within the AEU. With regard to criterion 4, a high maximum concentration and/or high frequency of detection in the AEU surface soil or sediment may also indicate a potential source for the analyte in surface water within the AEU.

For sediment, professional judgment indicates whether the analytes are likely to be ECOPCs in the AEU based on 1) a listing of the analytes (or classes of analytes) as constituents in wastes potentially released at historical IHSSs in the AEU (DOE 2005a), 2) the historical inventory for the analyte at RFETS (CDH 1991), 3) the maximum detected concentration and detection frequency of the analyte in AEU and sitewide sediment, and 4) the maximum detected concentration and detection frequency in AEU surface soil. The comparison of the AEU and sitewide maximum detected concentrations and detection frequencies (criterion 3) is performed to assess if the AEU observations are much higher, which may indicate a potential historical source for the analyte within the AEU. With regard to criterion 4, a high maximum concentration and/or high frequency of detection in the AEU surface soil may also indicate a potential historical source for the analyte in within the AEU.

The professional judgment analysis results in categorizing the analytes into groups (categories) with an ascending order of potential to be ECOPCs, and accordingly, contributing greater uncertainty in the risk estimates. For surface water, the criteria for each category are as follows:

Category 1

- low historical inventory at RFETS (< 1 kg);
- are not listed as waste constituents for the AEU historical IHSSs;
- are not detected in the AEU surface soil or sediment; and
- are not detected in the AEU or sitewide surface water.

Category 2

- low historical inventory at RFETS (< 1 kg);
- are not detected in the AEU surface soil or sediment; and
- are not detected in the AEU surface water but are detected in sitewide surface water.

Category 3

- low historical inventory at RFETS (< 1 kg); and
- are detected in sitewide surface water, and are detected in either the AEU surface soil/sediment or the AEU surface water but the maximum detected concentration in the AEU surface water is no greater than 10 times the chronic ESL.

Category 4

- are detected in the AEU surface soil/sediment; and
- are detected in the AEU surface water and sitewide surface water, and the maximum detected concentration in the AEU surface water is greater than 10 times the chronic ESL.

For sediment, the criteria for each category are as follows:

Category 1

- low historical inventory at RFETS (< 1 kg);
- are not listed as waste constituents for the AEU historical IHSSs;
- are not detected in the AEU surface soil; and
- are not detected in the AEU or sitewide sediment.

Category 2

- low historical inventory at RFETS (< 1 kg);
- are not detected in the AEU surface soil; and
- are not detected in the AEU sediment but are detected in sitewide sediment.

Category 3

- low historical inventory at RFETS (< 1 kg); and
- are detected in sitewide sediment, and are detected in either the AEU surface soil or the AEU sediment but the maximum detected concentration in the AEU sediment is no greater than 10 times the ESL.

Category 4

- are detected in the AEU surface soil; and
- are detected in the AEU sediment and sitewide sediment, and the maximum detected concentration in the AEU sediment is greater than 10 times the ESL.

Based on professional judgment, the uncertainty in the risk estimates is considered low for categories 1 and 2, moderate to high for category 3, and high for category 4. Accordingly, analytes in categories 3 and 4 are considered to have potential to be ECOPCs had the analytes been detected using lower detection limits.

The assessment of the ecological risk potential compares the maximum detection limit of the analyte to the chronic ESL and to the acute effect level in surface water, and to a Lowest Observed Effect Concentration (LOEC) in sediment. For surface water, a maximum detection limit/chronic ESL ratio greater than one indicates a potential for chronic effects if the analyte was actually present at the highest detection limit. A maximum detection limit/acute effect level ratio greater than one indicates a potential for an acute ecological effect if the analyte was actually present at the highest detection limit. For sediment, a maximum detection limit/LOEC ratio greater than one for sediment indicates a potential for an adverse ecological effect if the analyte was actually present at the highest detection limit.

Laboratory reported results for “U” qualified data (nondetects) are used to perform the detection limit screen rather than the detection limit identified in the detection limit field within the Soil Water Database (SWD). The basis for the detection limit is not always provided in SWD, e.g., Instrument Detection Limit (IDL), Method Detection Limit (MDL), Reporting Limit (RL), and Sample Quantitation Limit (SQL). Therefore, to be consistent in reporting, the “reported results” are presented in the tables to this attachment. Also, for statistical computations and risk estimations presented in the main text and tables to this volume, one-half the reported results are used as proxy values for nondetected data.

The term analyte as used in the following sections refers to analytes that are non-detected or detected in less than 5 percent of the samples. ESLs do not exist for some of these analytes, which is also a source of uncertainty for the risk assessment. This uncertainty is discussed in Section 6.4 of the main text of this volume.

1.1 Comparison of Reported Results to Ecological Screening Levels

1.1.1 No Name Gulch Aquatic Exposure Unit (NN AEU)

Surface Water

As shown in Table A1.2NNAEU.1, there are 33 analytes in surface water where some percent of the reported results exceed the chronic effects ESL. For 4 of these analytes, more than 60% (and often more than 95%) of the reported results are less than the chronic effects ESL. Consequently, for these analytes, there is minimal uncertainty in the overall risk estimates because of these higher reported results. Of the remaining 29, greater than 50% (and often 100%) of the reported results exceed the chronic effects ESL, and in some cases, the maximum reported results are 1 to 3 orders of magnitude higher than the chronic effects ESL. This condition requires further analysis to determine the extent of uncertainty in the overall risk estimates.

First, for these remaining 29 analytes, it is noted that the reported results are generally consistent with industry standards for laboratory detection limits. In all cases, the minimum reported results (see Table A1.2NNAEU.1) are similar in magnitude, if not substantially lower, than the Contract Required Quantitation Limits (CRQLs) for the Environmental Protection Agency's (EPA) Contract Laboratory Program (CLP) (5-20 ug/L for semi-volatile organic compounds (SVOCs), 0.01-0.1 ug/L for pesticides, and 0.2-0.4 ug/L for polychlorinated biphenyls (PCBs) depending on the compound). The CRQLs are minimum limits established by the CLP for identifying contaminants at Superfund sites.

Even though the lower limit of the range of reported results are generally consistent with industry standards for laboratory detection limits, the extent of uncertainty in the overall risk estimates was further assessed based on professional judgment and ecological risk potential.

As shown in Table A1.2NNAEU.2, many of the 29 analytes are in categories 3 and 4, and thus have potential to be ECOPCs in NN AEU surface water had the analytes been detected more frequently using lower detection limits. The category 3 analytes include cadmium (dissolved), cadmium (total), 4,4'-DDT, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzoic acid, heptachlor epoxide, PCB-1254, PCB-1260, and pentachlorophenol. Pyrene is the only category 4 analyte, i.e., it has the greatest potential to be an ECOPC in NN AEU surface water based on professional judgment. It is also an ECOPC for sediment in the NN AEU.

As shown in Table A1.2NNAEU.2, comparing the maximum reported results to the chronic ESLs and acute effects values (where available), indicates all the listed analytes would present a potential for chronic ecological effects, and many of the analytes would present a potential for acute ecological effects if they were detected at the maximum reported results. This includes the category 3 analytes, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzoic acid, and pentachlorophenol.

Therefore, there is moderate to high uncertainty in the overall risk estimates because of the higher reported results for the category 3 and 4 analytes, i.e., overall risks to the NN AEU aquatic populations may be underestimated because these category 3 and 4 analytes may have been included as ECOPCs for surface water had the analytes been detected at higher frequencies using lower detection limits (lower reported results). The uncertainty is somewhat greater for anthracene, benzo(a)anthracene, benzo(a)pyrene, benzoic acid, and pentachlorophenol because they also present a potential for acute ecological effects if they were detected at the maximum reported results.

Sediment

As shown in Table A1.2NWAEU.3, there are 41 analytes in sediment where some percent of the reported results exceed the lowest ESL. For four of these analytes, more than 50% of the reported results are less than the lowest ESL. Consequently, for these analytes, there is minimal uncertainty in the overall risk estimates because of these higher reported results. Of the remaining 37, greater than 50% (and often 100%) of the reported results exceed the lowest ESL, and in some cases, the maximum reported results are 1 to 3 orders of magnitude higher than the lowest ESL. This condition requires further analysis to determine the extent of uncertainty in the overall risk estimates.

First, for the remaining 37 analytes, it is noted that the reported results are generally consistent with industry standards for laboratory detection limits. In all cases, the minimum reported results (see Table A1.2NNAEU.3) are similar in magnitude to the Contract Required Quantitation Limits (CRQLs) for the Environmental Protection Agency’s (EPA) Contract Laboratory Program (CLP) (330-830 ug/kg for semi-volatile organic compounds (SVOCs); 1.7-3.3 ug/kg for pesticides; and 33-67 ug/kg for PCBs depending on the compound). The CRQLs are minimum limits established by the CLP for identifying contaminants at Superfund sites.

Even though the lower limit of the range of reported results are generally consistent with industry standards for laboratory detection limits, the extent of uncertainty in the overall risk estimates was further assessed based on professional judgment, and ecological risk potential.

As shown in Table A1.2NNAEU.4, many of the 37 analytes are in categories 1 and 2, and thus are not likely to be ECOPCs in the NN AEU sediment based on professional judgment. Category 3 analytes include 2-methylnaphthalene, 4,4’-DDT, acenaphthene, acenaphthylene, dibenz(a,h)anthracene, dibenzofuran, diethylphthalate, fluorene, heptachlor epoxide, PCB-1254, PCB-1260, and pentachlorophenol. There are no category 4 analytes. The category 3 analytes have potential to be ECOPCs in NN AEU sediment had the analytes been detected more frequently using lower detection limits.

As shown in Table A1.2NWAEU.4, comparing the maximum reported results to the LOEC, where available, indicates that most of the analytes would present a potential for adverse ecological effects if they were detected at the maximum reported results, including the category 3 analytes 2-methylnaphthalene, acenaphthene, dibenz(a,h)anthracene, fluorene, and pentachlorophenol.

Therefore, there is moderate to high uncertainty in the overall risk estimates because of the higher reported results for the category 3 analytes, i.e., overall risks to the NN AEU aquatic populations may be underestimated because the category 3 analytes may have been included as ECOPCs for sediment had they been detected more frequently using lower detection limits (lower reported results). 2-methylnaphthalene, acenaphthene, dibenz(a,h)anthracene, fluorene, and pentachlorophenol would also present a potential for adverse ecological effects if they were detected at the maximum reported results.

1.1.2 Rock Creek Aquatic Exposure Unit (RC AEU)

Surface Water

As shown in Table A1.2RCAEU.1, there are 35 analytes in surface water where some percent of the reported results exceed the chronic effects ESL. For five of these analytes, more than 75% (and often more than 95%) of the reported results are less than the chronic effects ESL. Consequently, for these analytes, there is minimal uncertainty in the overall risk estimates because of these higher reported results. Of the remaining 30, greater than 50% (and often 100%) of the reported results exceed the chronic effects ESL, and in some cases, the maximum reported results are 1 to 3 orders of magnitude higher than the chronic effects ESL. This condition requires further analysis to determine the extent of uncertainty in the overall risk estimates.

First, for these remaining 30 analytes, it is noted that the reported results are generally consistent with industry standards for laboratory detection limits. In all cases, the minimum reported results (see Table A1.2RCAEU.1) are similar in magnitude, if not substantially lower, than the Contract Required Quantitation Limits (CRQLs) for the Environmental Protection Agency's (EPA) Contract Laboratory Program (CLP) (5-20 ug/L for semi-volatile organic compounds (SVOCs), 0.01-0.1 ug/L for pesticides, and 0.2-0.4 ug/L for polychlorinated biphenyls (PCBs) depending on the compound). The CRQLs are minimum limits established by the CLP for identifying contaminants at Superfund sites.

Even though the lower limit of the range of reported results are generally consistent with industry standards for laboratory detection limits, the extent of uncertainty in the overall risk estimates was further assessed based on professional judgment and ecological risk potential.

As shown in Table A1.2RCAEU.2, several of the 30 analytes are in category 3, and thus have potential to be ECOPCs in RC AEU surface water if the analytes had been detected more frequently using lower detection limits. The category 3 analytes include silver (dissolved), silver (total), benzo(a)anthracene, benzo(a)pyrene, benzoic acid, di-n-butylphthalate, pentachlorophenol, phenanthrene, and pyrene. There are no category 4 analytes, and none of the category 3 analytes are ECOPCs in sediment for the RC AEU.

As shown in Table A1.2RCAEU.2, comparing the maximum reported results to the chronic ESLs and acute effects values (where available), indicates all the listed analytes would present a potential for chronic ecological effects, and a few of the analytes would present a potential for acute ecological effects if they were detected at the maximum reported results. The category 3 analytes with potential for acute effects include benzo(a)anthracene, benzo(a)pyrene, and pentachlorophenol.

Therefore, there is moderate to high uncertainty in the overall risk estimates because of the higher reported results for the category 3 analytes, i.e., overall risks to the RC AEU aquatic populations may be underestimated because these category 3 analytes may have been included as ECOPCs for surface water had the analytes been detected at higher frequencies using lower detection limits (lower reported results). The uncertainty is somewhat greater for benzo(a)anthracene, benzo(a)pyrene, and pentachlorophenol because they also present a potential for acute ecological effects if they were detected at the maximum reported results.

Sediment

As shown in Table A1.2RCAEU.3, there are 42 analytes in sediment where some percent of the reported results exceed the lowest ESL. Of these analytes, greater than 80% (and often 100%) of the reported results exceed the lowest ESL, and in some cases, the maximum reported results are 1 to 3 orders of magnitude higher than the lowest ESL. This condition requires further analysis to determine the extent of uncertainty in the overall risk estimates.

First, for these 42 analytes, it is noted that the reported results are generally consistent with industry standards for laboratory detection limits. In all cases, the minimum reported results (see Table A1.2RCAEU.3) are similar in magnitude to the Contract Required Quantitation Limits (CRQLs) for the Environmental Protection Agency's (EPA) Contract Laboratory Program (CLP) (330-830 ug/kg for semi-volatile organic compounds (SVOCs); 1.7-3.3 ug/kg for pesticides; and 33-67 ug/kg for PCBs depending on the compound). The CRQLs are minimum limits established by the CLP for identifying contaminants at Superfund sites.

Even though the lower limit of the range of reported results are generally consistent with industry standards for laboratory detection limits, the extent of uncertainty in the overall risk estimates was further assessed based on professional judgment, and ecological risk potential.

As shown in Table A1.2RCAEU.4, several of the 42 analytes are in category 3, and thus have potential to be ECOPCs in RC AEU sediment if the analytes had been detected more frequently using lower detection limits. The category 3 analytes include 2-methylnaphthalene, acenaphthene, anthracene, benzo(g,h,i)perylene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene. In accordance with the criteria for classifying these analytes, they are all technically category 2. However, because they are listed waste constituents for RC AEU IHSSs, and the sitewide maximum detected concentrations in sediment are greater than 10 times the ESLs, they have been classified as category 3 to be conservative. There are no category 4 analytes.

As shown in Table A1.2RCAEU.4, comparing the maximum reported results to the LOEC, where available, indicates that most of the analytes, and all of the category 3 analytes, would present a potential for adverse ecological effects if they were detected at the maximum reported results.

Therefore, there is moderate to high uncertainty in the overall risk estimates because of the higher reported results for the category 3 analytes, i.e., overall risks to the RC AEU aquatic populations may be underestimated because the category 3 analytes may have been included as ECOPCs for sediment had they been detected more frequently using lower detection limits (lower reported results). Furthermore, all of the category 3 analytes would also present a potential for adverse ecological effects if they were detected at the maximum reported results.

1.1.3 McKay Ditch Aquatic Exposure Unit (MK AEU)

Surface Water

As shown in Table A1.2MKAEU.1, there are 39 analytes in surface water where some percent of the reported results exceed the chronic effects ESL. For 4 of these analytes, more than 60% (and often more than 80%) of the reported results are less than the chronic effects ESL. Consequently, for these analytes, there is minimal uncertainty in the overall risk estimates because of these higher reported results. Of the remaining 35, greater than 50% (and often 100%) of the reported results exceed the chronic effects ESL, and in some cases, the maximum reported results are 1 to 3 orders of magnitude higher than the chronic effects ESL. This condition requires further analysis to determine the extent of uncertainty in the overall risk estimates.

First, for these remaining 35 analytes, it is noted that the reported results are generally consistent with industry standards for laboratory detection limits. In all cases, the minimum reported results (see Table A1.2MKAEU.1) are similar in magnitude, if not substantially lower, than the Contract Required Quantitation Limits (CRQLs) for the Environmental Protection Agency's (EPA) Contract Laboratory Program (CLP) (5-20 ug/L for semi-volatile organic compounds (SVOCs), 0.01-0.1 ug/L for pesticides, and 0.2-0.4 ug/L for polychlorinated biphenyls (PCBs) depending on the compound). The

CRQLs are minimum limits established by the CLP for identifying contaminants at Superfund sites.

Even though the lower limit of the range of reported results are generally consistent with industry standards for laboratory detection limits, the extent of uncertainty in the overall risk estimates was further assessed based on professional judgment and ecological risk potential.

As shown in Table A1.2MKAEU.2, several of the 35 analytes are in categories 3 and 4, and thus have potential to be ECOPCs in MK AEU surface water if the analytes had been detected more frequently using lower detection limits. The category 3 analytes include benzo(a)anthracene, benzo(a)pyrene, di-n-butylphthalate, phenanthrene, and pyrene. In accordance with the criteria for classifying these analytes, benzo(a)anthracene and benzo(a)pyrene are technically category 2. However, because they are listed waste constituents for MK AEU IHSSs, and the sitewide maximum detected concentrations in surface water are greater than 10 times the ESLs, they have been classified as category 3 to be conservative. The category 4 analytes include cadmium (dissolved) and cadmium (total). Also, all of the category 3 and 4 analytes are listed waste constituent for MK AEU historical IHSSs. Furthermore, benzo(a)anthracene, benzo(a)pyrene, phenanthrene and pyrene are ECOPCs for sediment in the MK AEU (total polynuclear aromatic hydrocarbons is the actual ECOPC).

As shown in Table A1.2MKAEU.2, comparing the maximum reported results to the chronic ESLs and acute effects values (where available), indicates all the listed analytes would present a potential for chronic ecological effects, and a few of the analytes would present a potential for acute ecological effects if they were detected at the maximum reported results. Howeverm there were no category 3 and 4 analytes with potential for acute effects.

Therefore, there is moderate to high uncertainty in the overall risk estimates because of the higher reported results for the category 3 and 4 analytes, i.e., overall risks to the MK AEU aquatic populations may be underestimated because these category 3 and 4 analytes may have been included as ECOPCs for surface water had the analytes been detected at higher frequencies using lower detection limits (lower reported results). However, none of these analytes present a potential for acute ecological effects if they were detected at the maximum reported results.

Sediment

As shown in Table A1.2MKAEU.3, there are 48 analytes in sediment where some percent of the reported results exceed the lowest ESL. For silver, more than 75% of the reported results are less than the lowest ESL. Consequently, for this analyte, there is minimal uncertainty in the overall risk estimates because of these higher reported results. Of the remaining 47, greater than 50% (and often 100%) of the reported results exceed the lowest ESL, and in some cases, the maximum reported results are 1 to 3 orders of magnitude higher than the lowest ESL. This condition requires further analysis to determine the extent of uncertainty in the overall risk estimates.

First, for the remaining 47 analytes, it is noted that the reported results are generally consistent with industry standards for laboratory detection limits. In all cases, the minimum reported results (see Table A1.2MKAEU.3) are similar in magnitude to the Contract Required Quantitation Limits (CRQLs) for the Environmental Protection Agency's (EPA) Contract Laboratory Program (CLP) (330-830 ug/kg for semi-volatile organic compounds (SVOCs); 1.7-3.3 ug/kg for pesticides; and 33-67 ug/kg for PCBs depending on the compound). The CRQLs are minimum limits established by the CLP for identifying contaminants at Superfund sites.

Even though the lower limit of the range of reported results are generally consistent with industry standards for laboratory detection limits, the extent of uncertainty in the overall risk estimates was further assessed based on professional judgment, and ecological risk potential.

As shown in Table A1.2MKAEU.4, several of the 47 analytes are in category 3, and thus have potential to be ECOPCs in MK AEU sediment if the analytes had been detected more frequently using lower detection limits. The category 3 analytes include 2-methylnaphthalene, acenaphthene, anthracene, benzo(a)anthracene, benzo(g,h,i)perylene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene. In accordance with the criteria for classifying these analytes, they are all technically category 2. However, because they are listed waste constituents for MK AEU IHSSs, and the sitewide maximum detected concentrations in sediment are greater than 10 times the ESLs, they have been classified as category 3 to be conservative. There are no category 4 analytes.

As shown in Table A1.2MKAEU.4, comparing the maximum reported results to the LOEC, where available, indicates that most of the category 3 analytes would present a potential for adverse ecological effects if they were detected at the maximum reported results.

Therefore, there is moderate to high uncertainty in the overall risk estimates because of the higher reported results for the category 3 analytes, i.e., overall risks to the MK AEU aquatic populations may be underestimated because the category 3 analytes may have been included as ECOPCs for sediment had they been detected more frequently using lower detection limits (lower reported results). Furthermore, most of the category 3 analytes would also present a potential for adverse ecological effects if they were detected at the maximum reported results.

1.1.4 Southeast Aquatic Exposure Unit (SE AEU)

Surface Water

As shown in Table A1.2SEAEU.1, there are 29 analytes in surface water where the reported results exceed the chronic effects ESL. For all these analytes, 100% of the reported results are greater than the chronic effects ESLs, and in some cases, the maximum reported results are 1 to 3 orders of magnitude higher than the chronic effects ESLs. This condition requires further analysis to determine the extent of uncertainty in the overall risk estimates.

First, for these 29 analytes, it is noted that the reported results are generally consistent with industry standards for laboratory detection limits. In all cases, the minimum reported results (see Table A1.2SEAEU.1) are similar in magnitude, if not substantially lower, than the Contract Required Quantitation Limits (CRQLs) for the Environmental Protection Agency's (EPA) Contract Laboratory Program (CLP) (5-20 ug/L for semi-volatile organic compounds (SVOCs), 0.01-0.1 ug/L for pesticides, and 0.2-0.4 ug/L for polychlorinated biphenyls (PCBs) depending on the compound). The CRQLs are minimum limits established by the CLP for identifying contaminants at Superfund sites.

Even though the lower limit of the range of reported results are generally consistent with industry standards for laboratory detection limits, the extent of uncertainty in the overall risk estimates was further assessed based on professional judgment and ecological risk potential.

As shown in Table A1.2SEAEU.2, only four of the 29 analytes are in category 3, and thus have potential to be ECOPCs in SE AEU surface water if the analytes had been detected more frequently using lower detection limits. The category 3 analytes are cadmium (dissolved), cadmium (total), benzo(a)anthracene, and benzo(a)pyrene. In accordance with the criteria for classifying these analytes, benzo(a)anthracene and benzo(a)pyrene are technically category 2. However, because they are listed waste constituents for SE AEU IHSSs, and the sitewide maximum detected concentrations in surface water are greater than 10 times the ESLs, they have been classified as category 3 to be conservative. There are no category 4 analytes, and the category 3 analytes are not ECOPCs in sediment for the SE AEU.

As shown in Table A1.2SEAEU.2, comparing the maximum reported results to the chronic ESLs and acute effects values (where available), indicates all the listed analytes would present a potential for chronic ecological effects, and a few of the analytes would present a potential for acute ecological effects if they were detected at the maximum reported results. However, none of the category 3 analytes have a potential for acute effects.

Therefore, there is moderate to high uncertainty in the overall risk estimates because of the higher reported results for the category 3 analytes (cadmium (dissolved), cadmium (total), benzo(a)anthracene, and benzo(a)pyrene), i.e., overall risks to the SE AEU aquatic populations may be underestimated because these category 3 analytes may have been included as ECOPCs for surface water had the analytes been detected at higher frequencies using lower detection limits (lower reported results). However, none of the category 3 analytes would present a potential for acute ecological effects if they were detected at the maximum reported results.

Sediment

As shown in Table A1.2SEAEU.3, none of the metal analytes in sediment have reported results that exceed the ESL. SE AEU sediment samples were not analyzed for organics.

2.0 REFERENCES

CDH, 1991. Colorado Department of Health Project Task 1 Report (Revised 1), Identification of Chemicals and Radionuclides Used at Rocky Flats. Prepared by ChemRisk. March.

DOE, 2005a, 2005 Annual Update to the Historical Release Report, Rocky Flats Environmental Technology Site, October.

DOE, 2005b. Final Comprehensive Risk Assessment Work Plan and Methodology, Revision 1, Rocky Flats Environmental Technology Site, Golden, Colorado. Revision 1. September.

TABLES

Table A1.2.1
Sitewide Summary Statistics for Analytes in Surface Water (Total and Dissolved) with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Total Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
Inorganic (Dissolved) (mg/L)								
Aluminum	1,130	36.7	415	0.00510	11.6	0.00130	0.149	0.0870
Antimony	1,159	19.2	222	3.40E-04	0.219	1.21E-04	0.358	0.240
Arsenic	1,135	24.4	277	4.40E-04	0.0116	1.50E-04	0.162	0.150
Barium	1,159	98.2	1,138	0.00250	0.844	0.00100	0.195	0.438
Beryllium	1,160	4.66	54	3.00E-05	0.00160	1.50E-05	0.01000	0.00240
Cadmium	1,782	18.8	335	1.60E-05	0.0305	1.70E-05	0.100	2.50E-04
Calcium	1,158	99.9	1,157	1.53	856	0.0732	0.0732	
Cerium	18	55.6	10	1.20E-04	7.20E-04	1.00E-04	1.00E-04	
Cesium	753	17.8	134	1.08E-04	0.140	1.00E-04	1	
Chloride	3	100	3	29.8	76.8			230,000
Chromium	1,161	10.8	125	2.20E-04	0.0868	5.00E-05	0.0275	0.0740
Cobalt	1,160	11.3	131	1.10E-04	0.0230	3.50E-05	0.0300	0.100
Copper	1,131	45.7	517	3.10E-04	0.205	4.50E-04	0.0250	0.00900
Fluoride	3	100	3	0.200	0.700			2.12
Iron	1,154	62.4	720	0.00260	95.8	0.00180	0.107	1
Lead	1,152	29.9	344	1.00E-04	0.111	1.60E-05	0.286	0.00250
Lithium	877	79.5	697	0.00110	2.33	0.00100	0.0849	0.0960
Magnesium	1,158	99.4	1,151	0.266	299	0.0170	0.0560	
Manganese	1,185	91.1	1,080	6.60E-04	2.13	4.60E-05	0.0226	1.65
Mercury	1,140	5.09	58	1.40E-05	0.00477	1.40E-05	4.00E-04	7.70E-04
Molybdenum	908	30.7	279	3.30E-04	0.0202	2.20E-04	0.200	0.800
Nickel	1,153	18.2	210	3.00E-04	0.170	1.40E-04	0.0400	0.0520
Phosphate	12					0.0200	0.0200	
Potassium	1,156	94.1	1,088	0.270	1,270	0.0800	6.07	
Selenium	1,161	24.7	287	2.30E-04	0.0485	4.00E-04	0.0540	0.00460
Silica	9	88.9	8	1	5.30	0.400	0.400	
Silicon	746	99.7	744	0.0596	26.4	0.0452	0.100	
Silver	1,785	6.72	120	2.00E-05	0.0332	5.00E-06	0.0200	3.20E-04
Sodium	1,158	99.9	1,157	0.270	2,350	0.0190	0.0190	
Strontium	910	99.0	901	0.00540	8.50	0.00100	0.205	8.30

Table A1.2.1
Sitewide Summary Statistics for Analytes in Surface Water (Total and Dissolved) with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Total Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
Sulfate	3	100	3	10	52			
Sulfide	1					1	1	
Thallium	1,145	2.79	32	1.20E-05	0.0179	5.00E-06	0.191	0.0150
Tin	808	4.21	34	0.00150	0.206	9.80E-05	0.200	0.0730
Uranium	58	29.3	17	0.00231	0.0170	0.00240	0.0703	1.50
Vanadium	1,155	31.3	362	1.90E-04	0.0790	9.50E-05	0.0500	0.0120
Zinc	1,153	59.7	688	0.00180	1.50	0.00100	0.0594	0.118
Inorganic (Total) (mg/L)								
Aluminum	2,443	93.3	2,279	0.00655	442	0.00650	0.281	0.0870
Ammonia	799	68.0	543	0	24.4	0.0300	1	0.0200
Antimony	2,453	33.1	812	4.10E-04	0.226	1.00E-04	0.456	0.240
Arsenic	2,423	53.3	1,292	4.00E-04	0.147	3.50E-04	5.30	0.150
Barium	2,456	98.0	2,406	1.50E-04	4.52	1.60E-04	0.200	0.438
Beryllium	3,039	35.2	1,070	1.00E-05	0.0270	1.00E-05	0.01000	0.00240
Boron	10	60	6	0.0140	0.180	0.0130	0.0130	1.90
Bromide	5	20	1	0.820	0.820	0.500	0.500	
Cadmium	2,466	34.5	852	5.00E-05	0.0483	3.00E-05	0.0292	2.50E-04
Calcium	2,460	99.9	2,457	0.0381	1,118	0.0258	0.0441	
Cerium	18	100	18	4.90E-04	0.124			
Cesium	887	12.2	108	2.20E-04	0.130	1.00E-04	0.617	
Chloride	1,318	98.9	1,303	-1.70	460	0.200	5	230,000
Chromium	3,354	50.9	1,706	5.10E-06	0.434	5.00E-06	0.0283	0.0740
Chromium VI	100	7	7	0.0100	0.0600	0.01000	0.0200	
Cobalt	2,453	43.5	1,067	1.20E-04	0.253	1.20E-04	0.0300	0.100
Copper	2,426	71.7	1,739	3.00E-04	0.623	3.50E-04	0.0450	0.00900
Cyanide	471	7.86	37	0	0.146	0	0.0500	5.00E-04
Fluoride	1,245	93.0	1,158	0.0500	9.60	0.0400	0.660	2.12
Hydrogen Sulfide	1					1	1	
Iron	2,457	98.0	2,407	0.00520	481	0.00700	0.181	1
Lead	2,438	63.8	1,556	8.10E-05	5.90	5.00E-05	0.0730	0.00250
Lithium	2,045	87.3	1,785	8.00E-05	2.97	0.00100	0.0668	0.0960

Table A1.2.1
Sitewide Summary Statistics for Analytes in Surface Water (Total and Dissolved) with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Total Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
Magnesium	2,460	99.7	2,453	0.00833	300	0.00740	4.83	
Manganese	2,457	97.3	2,390	7.00E-05	7.77	2.20E-04	0.0244	1.65
Mercury	2,319	11.0	254	0	0.0131	1.30E-05	0.00900	7.70E-04
Molybdenum	2,134	53.4	1,139	2.80E-04	0.0430	2.20E-04	0.200	0.800
Nickel	2,431	52.6	1,278	3.70E-04	0.479	2.50E-04	0.0400	0.0520
Nitrate / Nitrite	3,710	89.7	3,327	0.0110	4,370	0.01000	4	
Nitrite	443	27.1	120	0.0200	3.43	0.01000	10	4.47
Ortho-phosphate	282	15.2	43	0.0280	0.580	0.0200	0.0500	
Phosphate	157	42.0	66	0.0100	0.760	0.01000	0.100	
Phosphorus	475	51.4	244	-0.0100	5.70	0.01000	0.100	
Potassium	2,453	96.2	2,360	0.00720	1,530	0.00880	7.69	
Selenium	2,430	30.1	732	3.20E-04	0.0485	2.00E-04	4.50	0.00460
Silica	33	100	33	0.0104	26.4			
Silicon	962	99.7	959	0.0284	208	0.0120	0.332	
Silver	2,454	11.7	288	4.00E-05	0.913	4.00E-05	0.0321	3.20E-04
Sodium	2,453	99.9	2,451	0.0512	6,460	0.0423	0.0491	
Strontium	2,128	99.4	2,116	2.00E-04	8.59	5.00E-04	0.167	8.30
Sulfate	1,323	98.2	1,299	0.460	697	0.500	10	
Sulfide	455	9.89	45	0.0160	36	4.00E-04	4	
Thallium	2,440	5.57	136	2.00E-04	0.0200	2.00E-05	5.20	0.0150
Tin	1,970	9.95	196	5.20E-04	0.315	4.80E-04	0.200	0.0730
Titanium	21	57.1	12	0.00270	0.0350	0.00260	0.00300	
Total Petroleum Hydrocarbons	9	66.7	6	0.170	0.550	1	1	
Uranium	811	17.8	144	5.96E-04	0.0770	0.00200	0.120	1.50
Vanadium	2,451	65.6	1,608	1.30E-04	0.892	1.20E-04	0.0500	0.0120
Zinc	2,453	86.7	2,127	7.20E-04	16.4	5.00E-04	0.120	0.118
Organic (ug/L)								
1,1,1,2-Tetrachloroethane	606					0.100	10	
1,1,1-Trichloroethane	1,382	17.5	242	0.100	20	0.100	10	89
1,1,2,2-Tetrachloroethane	1,383	0.145	2	0.100	1	0.100	10	2,400
1,1,2-Trichloro-1,2,2-trifluoroetha	142	2.82	4	4	19.8	0.200	5	32

Table A1.2.1
Sitewide Summary Statistics for Analytes in Surface Water (Total and Dissolved) with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Total Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
1,1,2-Trichlorobenzene	3					1	1	
1,1,2-Trichloroethane	1,384					0.100	10	940
1,1-Dichloroethane	1,384	19.8	274	0.180	10	0.100	10	740
1,1-Dichloroethene	1,382	9.62	133	0.200	11	0.200	10	65
1,1-Dichloropropene	619					0.100	10	
1,2,3-Trichlorobenzene	619	0.162	1	0.700	0.700	0.100	10	8
1,2,3-Trichloropropane	594	0.168	1	0.600	0.600	0.100	20	
1,2,4,5-Tetrachlorobenzene	3					10	33	
1,2,4-Trichlorobenzene	895	0.223	2	0.130	3	0.100	18	50
1,2,4-Trimethylbenzene	619	0.323	2	0.120	2	0.100	10	17
1,2-Dibromo-3-chloropropane	376	0.266	1	0.600	0.600	0.160	20	
1,2-Dibromoethane	620					0.200	20	
1,2-Dichlorobenzene	950					0.100	18	13
1,2-Dichloroethane	1,361	0.808	11	0.500	14	0.100	10	20,000
1,2-Dichloroethene	781	18.3	143	1	370	5	10	1,100
1,2-Dichloropropane	1,384	0.145	2	0.480	0.960	0.100	10	5,700
1,3 & 1,4-xylene	2					5	5	35
1,3,5-Trimethylbenzene	619					0.100	10	45
1,3,5-Trinitrobenzene	3					10	33	
1,3-Dichlorobenzene	950	0.316	3	0.440	0.820	0.100	18	28
1,3-Dichloropropane	617					0.100	10	
1,3-Dinitrobenzene	3					10	33	
1,4-Dichlorobenzene	950	0.947	9	0.120	0.500	0.100	18	16
1,4-Naphthoquinone	3					10	33	
1,4-Phenylenediamine	3					10	33	
1-Naphthylamine	3					10	33	
2,2-Dichloropropane	614					0.100	10	
2,3,4,6-Tetrachlorophenol	3					10	33	
2,4,5-T	48					0.100	10	
2,4,5-TP (Silvex)	125					0.100	10	
2,4,5-Trichlorophenol	473					9.80	330	

Table A1.2.1
Sitewide Summary Statistics for Analytes in Surface Water (Total and Dissolved) with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Total Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
2,4,6-Trichlorophenol	473					1	330	5
2,4-D	125					0.450	13	
2,4-DB	45					0.910	10	
2,4-Dichlorophenol	473					5	330	365
2,4-Dimethylphenol	473	0.423	2	2	3	5	330	212
2,4-Dinitrophenol	455					23	1,700	
2,4-Dinitrotoluene	474					5	330	
2,6-Dichlorophenol	3					10	33	
2,6-Dinitrotoluene	475					5	330	
2378-TCDD	74					1.00E-04	0.00500	
2-Acetylaminofluorene	3					10	33	
2-Butanone	838	2.27	19	1	17	2	100	2,200
2-Chloroethyl vinyl ether	83	1.20	1	0	0	0	10	
2-Chloronaphthalene	478					5	330	630
2-Chlorophenol	473					5	330	
2-Chlorotoluene	619					0.200	10	
2-Hexanone	905	0.552	5	1	12	1	50	99
2-Methyl-1-propanol	1					2,000	2,000	
2-Methylnaphthalene	474	1.27	6	6.20	23	5	330	
2-Methylphenol	470					5	330	82
2-Naphthylamine	3					10	33	
2-Nitroaniline	478					23	1,700	
2-Nitrophenol	473					5	330	
2-Picoline	3					10	33	
3 & 4-methyl phenol	27					9.80	11.2	
3,3'-Dichlorobenzidine	465					9	670	
3,3'-Dimethylbenzidine	3					10	33	
3-Methylcholanthrene	3					10	33	
3-Nitroaniline	472					23	1,700	
4,4'-DDD	311	0.643	2	0.0460	0.0990	0.0200	1	0.0600
4,4'-DDE	311	1.29	4	0.0130	0.0490	0.0200	1	105

Table A1.2.1
Sitewide Summary Statistics for Analytes in Surface Water (Total and Dissolved) with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Total Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
4,4'-DDT	311	3.54	11	0.0100	0.580	0.0200	1	0.00100
4,6-Dinitro-2-methylphenol	467					10	1,700	
4-Aminobiphenyl	3					10	33	
4-Bromofluorobenzene	1	100	1	9.49	9.49			
4-Bromophenyl-phenylether	478	0.209	1	3	3	5	330	
4-Chloro-3-methylphenol	473					5	670	
4-Chloroaniline	474					5	670	
4-Chlorophenyl-phenyl ether	478					5	330	
4-Chlorotoluene	619					0.200	10	
4-Isopropyltoluene	619	0.162	1	3	3	0.200	10	
4-Methyl-2-pentanone	897	0.446	4	3	11	1	50	170
4-Methylphenol	443	0.677	3	2	28	5	330	25
4-Nitroaniline	465	0.430	2	1.10	5.30	5	1,700	
4-Nitrophenol	468					23	1,700	
5-Nitro-o-toluidine	3					10	33	
7,12-Dimethylbenz(a)-anthracene	3					10	33	
a,a-Dimethylphenethylamine	3					10	33	
Acenaphthene	479	1.67	8	0.500	4	1	330	520
Acenaphthylene	478	0.209	1	2	2	1	330	
Acetone	847	16.8	142	1	210	2	140	1,500
Acetonitrile	1					100	100	
Acetophenone	3					10	33	
Acrolein	1					500	500	
Acrylonitrile	46					10	100	
Aldrin	311					0.01000	0.520	0.150
Allyl Chloride	1					10	10	
alpha-BHC	311	2.25	7	0	0.360	0.01000	0.520	2.20
alpha-Chlordane	298	1.01	3	0	0	0.01000	5.20	
Ametryne	161					0.180	0.760	
Aniline	1					10	10	
Anthracene	478	0.209	1	2	2	0.0288	330	0.730

Table A1.2.1
Sitewide Summary Statistics for Analytes in Surface Water (Total and Dissolved) with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Total Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
Aramite	3					20	67	
Atraton	118	0.847	1	1	1	0.510	0.760	
Atrazine	187	27.8	52	0.0400	1.90	0.150	1.10	7.30
Azinphos-methyl	1					4	4	
Benzene	1,384	0.650	9	0.100	4.70	0.100	10	530
Benzidine	15					10	10	
Benzo(a)anthracene	478	0.209	1	8	8	0.130	330	0.0270
Benzo(a)pyrene	478	0.209	1	9	9	0.134	330	0.0140
Benzo(b)fluoranthene	476	0.420	2	2	10	0.144	33	
Benzo(b,k)fluoroanthene	2					10	330	
Benzo(g,h,i)perylene	465	0.430	2	4	7	0.588	330	
Benzo(k)fluoranthene	476	0.630	3	0.700	8	0.0768	33	
Benzoic Acid	401	1.50	6	3	42	25	1,700	42
Benzyl Alcohol	424	1.18	5	3	860	5	670	8.60
beta-BHC	311	4.50	14	0	0.170	0.01000	0.520	2.20
beta-Chlordane	169					0.0490	5.20	
bis(2-Chloroethoxy) methane	475					5	330	
bis(2-Chloroethyl) ether	475					5	330	
bis(2-Chloroisopropyl) ether	465					5	330	29
bis(2-ethylhexyl)phthalate	475	24	114	0.400	200	5	300	28.5
Bladex	43					0.300	0.300	
Bromobenzene	619					0.200	10	
Bromochloromethane	607	0.329	2	4	5	0.100	10	
Bromodichloromethane	1,369	0.730	10	0.210	4	0.200	10	1,100
Bromoform	1,370	0.146	2	0.100	1.90	0.200	10	320
Bromomethane	1,365					0.200	20	35
Butylbenzylphthalate	478	4.18	20	0.300	6	5	330	67
Carbazole	52	1.92	1	3	3	9	12	4
Carbon Disulfide	918	0.327	3	0.100	8	0.200	10	0.920
Carbon Tetrachloride	1,372	23.0	316	0.110	310	0.100	10	3,520
Chlordane (NOS)	13					0.500	0.500	

Table A1.2.1
Sitewide Summary Statistics for Analytes in Surface Water (Total and Dissolved) with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Total Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
Chlorobenzene	1,384	0.289	4	0.100	1	0.100	10	47
Chlorobenzilate	3					10	33	
Chlorodifluoromethane	16	100	16	2	98			
Chloroethane	1,374	0.655	9	21	62	0.200	20	
Chloroform	1,384	27.6	382	0.0800	120	0.100	10	1,240
Chloromethane	1,375	0.364	5	0.200	17	0.200	20	
Chlorpyriphos	1					1	1	
Chrysene	478	0.628	3	0.400	11	0.499	330	
cis-1,2-Dichloroethane	1	100	1	18	18			
cis-1,2-Dichloroethene	618	46.6	288	0.100	210	0.100	5	620
cis-1,3-Dichloropropene	1,376					0.100	10	244
Coumaphos	1					4	4	
Dalapon	45	2.22	1	0.990	0.990	1.10	10.5	
delta-BHC	311	1.61	5	0	0.180	0.01000	0.520	2.20
Demeton	1					2	2	
Diallate (cis or trans)	3					10	33	
Diazinon	1					1	1	
Dibenz(a,h)anthracene	469	0.213	1	2	2	0.300	330	
Dibenzofuran	479	1.04	5	1	2	5	330	4
Dibromochloromethane	1,381	0.217	3	0.240	1	0.200	10	
Dibromomethane	620					0.200	20	
Dicamba	45	11.1	5	0.0800	0.210	0.100	10	10
Dichlorodifluoromethane	675	0.741	5	0.270	2.18	0.200	20	
Dichlorofluoromethane	1	100	1	16	16			150
Dichloroprop	45	4.44	2	0.270	0.290	0.500	10	
Dichlorovos	1					2	2	
Dieldrin	311					0.0200	1	0.0560
Diethylphthalate	479	5.43	26	0.300	11	5	330	110
Dimethoate	3	66.7	2	0.620	67	0.510	0.510	
Dimethylaminoazobenzene	3					10	33	
Dimethylphthalate	478	0.837	4	0.790	3.60	5	330	

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Analyte	Total Number of Results	Detection Frequency (%)	Total Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
Di-n-butylphthalate	478	15.7	75	0.300	48	5	18	9.70
Di-n-octylphthalate	478	0.837	4	3	10	5	330	
Dinoseb	45	2.22	1	0.340	0.340	0.0700	10	0.480
Diphenylamine	32					9.80	33	
Disulfoton	4					0.510	1	
Endosulfan I	311	0.322	1	0.0100	0.0100	0.01000	0.520	0.0560
Endosulfan II	311					0.0200	1	0.0560
Endosulfan sulfate	311					0.0200	1	0.0560
Endrin	311	0.322	1	0.0210	0.0210	0.0200	1	0.0360
Endrin aldehyde	87					0.0200	1	0.0360
Endrin ketone	293					0.0500	1	0.0360
Ethoprop	1					1	1	
Ethyl Methacrylate	1					20	20	
Ethyl methanesulfonate	3					10	33	
Ethylbenzene	1,384	0.723	10	0.430	17	0.100	10	3,200
Famphur	3					1.30	1.30	
Fensulfothion	1					2	2	
Fenthion	1					1	1	
Fluoranthene	478	0.418	2	0.900	16	0.595	330	398
Fluorene	479	1.67	8	0.900	3	0.294	330	12
gamma-BHC (Lindane)	311	1.29	4	0	0	0.01000	0.520	0.0800
gamma-Chlordane	129	2.33	3	0	0	0.01000	2.60	
Heptachlor	311	0.965	3	0	0	0.01000	0.520	0.00380
Heptachlor epoxide	311	0.322	1	0.0500	0.0500	0.01000	0.520	0.00380
Hexachlorobenzene	478					1	330	
Hexachlorobutadiene	895	0.112	1	0.290	0.290	0.100	18	9.30
Hexachlorocyclopentadiene	470					5	330	
Hexachlorodibenzofuran	1					2.00E-04	2.00E-04	
Hexachlorodibenzo-p-dioxin	1					4.00E-04	4.00E-04	
Hexachloroethane	478					1	330	540
Hexachlorophene	3					100	330	

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Sitewide Summary Statistics for Analytes in Surface Water (Total and Dissolved) with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Total Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
Hexachloropropene	3					10	33	
Hexazinone	1	100	1	1.30	1.30			
Indeno(1,2,3-cd)pyrene	467	0.214	1	7	7	0.294	330	
Iodomethane	1					10	10	
Isodrin	3					0.100	0.110	
Isophorone	478	0.418	2	0.200	0.300	5	330	1,300
Isopropylbenzene	619					0.200	10	
Isosafrole	3					10	33	
Kepone	3					0.500	0.550	
m,p-Xylene	342	0.585	2	0.200	0.300	0.200	2	35
Malathion	1					1	1	
MCPA	45					10	10,000	
MCPP	45					10	10,000	
Merphos	1					5	5	
Methapyrilene	3					10	33	
Methoxychlor	298					0.0500	5.20	
Methyl Acrylonitrile	1					20	20	
methyl methacrylate	1					20	20	
Methyl methanesulfonate	3					10	33	
Methyl parathion	4					0.510	1	
Methylene Chloride	1,376	17.4	239	0.0900	90	0.100	71	940
Mevinphos	1					2	2	
m-Xylene	3					0.500	0.500	35
Naled	1					5	5	
Naphthalene	896	2.01	18	0.110	25	0.200	18	620
n-Butylbenzene	619	0.162	1	0.640	0.640	0.100	10	
Nitrobenzene	478					5	330	
Nitroquinoline-1-oxide	3					20	67	
N-Nitrosodiethylamine	18					5	33	
N-Nitrosodimethylamine	18					5	33	
N-Nitrosodi-n-butylamine	18					5	33	

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Analyte	Total Number of Results	Detection Frequency (%)	Total Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
N-Nitroso-di-n-propylamine	478					5	330	
N-nitrosodiphenylamine	449					5	330	
N-Nitrosomethylethylamine	3					10	33	
N-Nitrosomorpholine	3	33.3	1	1	1	10	33	
N-Nitrosopiperidine	3					51	170	
N-Nitrosopyrrolidine	18					10	33	
n-Propylbenzene	619					0.200	10	
O,O,O-Triethyl phosphorothioate	3					0.510	0.520	
o-Toluidine	3					10	33	
o-Xylene	438					0.200	5	35
Parathion	3					0.510	0.520	
PCB-1016	302					0.200	2.60	0.0140
PCB-1221	302					0.400	5	0.0140
PCB-1232	302					0.200	2.60	0.0140
PCB-1242	302					0.200	2.60	0.0140
PCB-1248	302					0.200	2.60	0.0140
PCB-1254	302	2.32	7	0.260	24	0.200	5.20	0.0140
PCB-1260	302					0.200	5.20	0.0140
Pentachlorobenzene	3					10	33	
Pentachlorodibenzofuran	1					5.00E-04	5.00E-04	
Pentachlorodibenzo-p-dioxin	1					0.00100	0.00100	
Pentachloroethane	1					20	20	
Pentachloronitrobenzene	1					51	51	
Pentachlorophenol	473	0.423	2	4	5	23	1,700	6.73
Phenacetin	3					10	33	
Phenanthrene	479	1.88	9	1	11	0.672	330	2.40
Phenol	477	0.629	3	3.50	5,000	5	5,000	2,560
Phorate	4					0.510	1	
Prometon	161	0.621	1	0.310	0.310	0.0900	0.380	
Prometryn	161					0.180	0.760	
Pronamide	3					10	33	

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Sitewide Summary Statistics for Analytes in Surface Water (Total and Dissolved) with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Total Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
Propazine	161	2.48	4	0.350	1	0.0900	0.380	
Prothiophos	1					5	5	
p-Xylene	1					0.500	0.500	35
Pyrene	474	1.27	6	0.200	12	0.588	330	0.0250
Ronnel	1					1	1	
Safrole	3					10	33	
sec-Butylbenzene	619					0.100	10	
Simazine	187	1.07	2	0.0800	0.180	0.180	1.10	10
Simetryn	161					0.210	730	
Styrene	1,329					0.100	10	160
Sulprofos	1					1	1	
TCDF	1					7.00E-04	7.00E-04	
Terbutryn	109					0.01000	0.630	
Terbutylazine	161					0.0900	0.380	
tert-Butylbenzene	619					0.200	10	
Tetrachlorodibenzo-p-dioxin	1					5.00E-04	5.00E-04	
Tetrachloroethane	3					1	1	
Tetrachloroethene	1,381	27.4	379	0.0500	280	0.0400	10	840
Tetrachlorvinphos	1					2	2	
Tetraethyl dithiopyrophosphate	3					0.510	0.520	
Thionazine	3					0.510	0.520	
Toluene	1,385	3.75	52	0.100	47	0.100	10	1,750
Toxaphene	311					0.980	10	
trans-1,2-Dichloroethene	674	1.48	10	0.100	1.10	0.100	10	1,500
trans-1,3-Dichloropropene	1,374					0.100	10	244
trans-1,4-Dichlorobutene-2	1					20	20	
Tributyl phosphate	29					98	112	
Trichloroethene	1,384	27.2	377	0.0400	970	0.0400	16	21,900
Trichlorofluoromethane	675	1.33	9	0.400	7	0.200	10	
Trichloronate	1					1	1	
Vinyl acetate	692					10	10	

Table A1.2.1
Sitewide Summary Statistics for Analytes in Surface Water (Total and Dissolved) with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Total Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
Vinyl Chloride	1,384	4.99	69	0.200	37	0.200	20	930
Xylene	1,042	1.15	12	1.30	24	0.500	10	35
Radionuclide (Dissolved)								
Americium-241	222	100	222	-0.0228	0.163	-0.00400	0.0140	43.8
Cesium-137	198	100	198	-0.788	2	-0.580	0.700	42.6
Curium-244	41	100	41	-0.0140	0.00600	-0.0140	0.00600	
Gross Alpha	196	100	196	-1.14	370	-0.800	6.30	
Gross Beta	223	100	223	0.480	1,111	0.480	2.30	
Neptunium-237	13	100	13	-0.0190	0.0540	-0.0190	0.0440	
Plutonium-239/240	224	100	224	-0.0630	0.100	-0.00200	0.00800	18.7
Radium-226	21	100	21	0.00932	1.34			1.02
Strontium-89/90	288	100	288	-0.190	4.04	-0.190	0.840	278
Thorium-230	19	100	19	-0.120	0.170	-0.120	0.110	
Thorium-232	19	100	19	-0.0580	0.0940	-0.0580	0.0940	
Uranium-233/234	330	100	330	-0.115	583	-0.115	0.246	20.1
Uranium-235	330	100	330	-0.112	17.8	-0.112	0.250	21.7
Uranium-238	330	100	330	-0.0609	253	-0.0120	0.334	22.3
Radionuclide (Tota) (pCi/L)								
Americium-241	4,547	100	4,547	-0.200	84	-0.200	0.314	43.8
Cesium-134	3	100	3	-0.0575	0.227			
Cesium-137	614	100	614	-0.734	9	-0.520	0.900	42.6
Curium-244	62	100	62	-0.0760	0.0260	-0.0760	0.0260	
Gross Alpha	3,638	100	3,638	-0.710	1,200	-0.710	64.9	
Gross Beta	3,684	100	3,684	-14	1,600	-14	46.9	
Neptunium-237	62	100	62	-0.263	0.238	-0.263	0.168	
Plutonium-238	719	100	719	-0.0108	11.9	-0.00400	0.500	
Plutonium-239/240	4,753	100	4,753	-0.190	259	-0.190	0.201	18.7
Radium-226	52	100	52	-0.190	21	-0.190	0.540	1.02
Radium-228	3	100	3	10	28			0.849
Strontium-89/90	658	100	658	-0.350	4.06	-0.350	0.890	278
Thorium-230	49	100	49	-0.200	0.890	-0.200	0.240	

Table A1.2.1
Sitewide Summary Statistics for Analytes in Surface Water (Total and Dissolved) with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Total Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
Thorium-232	49	100	49	-0.130	1	-0.130	0.180	
Tritium	3,284	100	3,284	-479	7,800	-359	380	
Uranium-233/234	3,897	100	3,897	-0.0900	1,161	-0.0900	0.990	20.1
Uranium-235	3,838	100	3,838	-0.120	31.0	-0.120	0.360	21.7
Uranium-238	3,897	100	3,897	-0.504	1,214	-0.504	0.526	22.3

Table A1.2.2
Sitewide Summary Statistics for Analytes in Sediment with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
Inorganic (mg/kg)								
Aluminum	386	100	386	763	49,000			15,900
Antimony	355	14.6	52	0.210	51.3	0.190	39.1	2
Arsenic	385	97.1	374	0.480	27.9	0.463	4.80	9.79
Barium	386	99.7	385	7.20	404	32.1	32.1	189
Beryllium	380	71.8	273	0.110	6.70	0.0900	1.90	
Boron	106	97.2	103	1.20	30	1.10	1.20	
Cadmium	377	41.1	155	0.0360	44	0.0270	4	0.990
Calcium	386	100	386	470	140,000			
Cesium	234	20.1	47	0.680	13.6	0.520	749	
Chloride	32	68.8	22	13	394	25	25	
Chromium	386	96.4	372	1.30	140	1.20	20	43.4
Chromium VI	42	33.3	14	0.00500	0.0130	0.00500	0.00500	43.4
Cobalt	384	93.8	360	1.30	20.1	0.950	10.6	
Copper	386	95.9	370	2.20	324	0.745	18.2	31.6
Cyanide	7	14.3	1	0.230	0.230	0.270	5	
Fluoride	42	52.4	22	0.831	20.3	0.875	2.50	0.0100
Iron	386	100	386	1,680	55,000			20,000
Lead	386	100	386	2	234			35.8
Lithium	379	84.7	321	1.60	37	1.40	28.4	
Magnesium	386	100	386	263	22,900			
Manganese	386	100	386	35.8	2,500			630
Mercury	353	36.5	129	0.0130	3.80	0.00500	0.620	0.180
Molybdenum	378	36.8	139	0.190	11.7	0.140	13	
Nickel	385	91.9	354	1.40	216	2.20	26.4	22.7
Nitrate / Nitrite	193	54.9	106	0.157	89.3	0.100	22.8	
Nitrite	36	2.78	1	5.61	5.61	0.0200	2.50	
Potassium	384	95.3	366	276	6,500	163	4,180	
Selenium	375	24.3	91	0.260	3.80	0.140	4.60	0.950
Silica	106	100	106	259	4,900			
Silicon	119	100	119	64.9	1,960			

Table A1.2.2
Sitewide Summary Statistics for Analytes in Sediment with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
Silver	371	17.3	64	0.0900	3,100	0.01000	6.30	1
Sodium	384	87.2	335	23.3	2,240	41.1	637	
Strontium	383	99.7	382	4.10	526	13.6	13.6	
Sulfate	32	31.3	10	3.81	95.9	25	25	
Sulfide	1	100	1	37	37			
Thallium	376	16.0	60	0.200	10	0.240	3.50	
Tin	377	17.2	65	0.920	77.2	0.660	127	
Titanium	106	100	106	36	330			
Uranium	135	5.93	8	1.10	20	0.960	39	
Vanadium	386	97.9	378	2.30	96	2.20	33.6	
Zinc	386	99.7	385	10.6	2,080	35.5	35.5	121
Organic (ug/kg)								
1,1,1,2-Tetrachloroethane	49					0.952	23	
1,1,1-Trichloroethane	248	0.403	1	9	9	0.841	1,600	159
1,1,2,2-Tetrachloroethane	247	0.405	1	2	2	0.928	1,600	1,900
1,1,2-Trichloro-1,2,2-trifluoroet	49					0.840	23	
1,1,2-Trichloroethane	248					0.922	1,600	
1,1-Dichloroethane	249					0.773	1,600	
1,1-Dichloroethene	248	0.403	1	2	2	0.873	1,600	
1,1-Dichloropropene	49					0.606	23	
1,2,3-Trichlorobenzene	49	2.04	1	2	2	0.696	23	58.6
1,2,3-Trichloropropane	49					1.03	23	
1,2,4-Trichlorobenzene	313	0.319	1	2	2	0.963	3,600	429
1,2,4-Trimethylbenzene	49	12.2	6	1.40	4.60	0.720	23	122
1,2-Dibromo-3-chloropropane	49					1.79	23	
1,2-Dibromoethane	49					0.816	23	
1,2-Dichlorobenzene	264					0.727	2,700	
1,2-Dichloroethane	245	0.408	1	5	5	0.991	1,600	
1,2-Dichloroethene	200	0.500	1	3	3	5	1,600	
1,2-Dichloropropane	248					0.747	1,600	
1,3,5-Trimethylbenzene	49					0.755	23	316

Table A1.2.2
Sitewide Summary Statistics for Analytes in Sediment with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
1,3-Dichlorobenzene	313					0.911	3,600	122
1,3-Dichloropropane	49					0.576	23	
1,4-Dichlorobenzene	264					1.10	2,700	
1,4-Dioxane	1					500	500	
1234678-HpCDF	6	83.3	5	8.07E-04	0.0298	0.00419	0.00419	
1234789-HpCDF	6	50	3	7.40E-04	0.00243	0.00226	0.00286	
123478-HxCDD	6	16.7	1	0.00126	0.00126	0.00226	0.00474	
123478-HxCDF	6	66.7	4	5.50E-04	0.00371	0.00271	0.00419	
123678-HxCDD	6	33.3	2	0.00122	0.00455	0.00226	0.00474	
123678-HxCDF	6	33.3	2	5.62E-04	0.00250	0.00271	0.00474	
123789-HxCDD	6	33.3	2	0.00106	0.00329	0.00226	0.00474	
123789-HxCDF	6	16.7	1	5.53E-04	5.53E-04	0.00184	0.00474	
12378-PeCDF	6	16.7	1	0.00197	0.00197	0.00226	0.00474	
2,2-Dichloropropane	49					0.667	23	
2,4,5-T	1					60	60	
2,4,5-TP (Silvex)	1					60	60	
2,4,5-Trichlorophenol	292					330	10,000	
2,4,6-Trichlorophenol	292					330	3,600	59.3
2,4-D	1					180	180	
2,4-DB	1					1,400	1,400	
2,4-Dichlorophenol	291					330	3,600	
2,4-Dimethylphenol	291					330	3,600	
2,4-Dinitrophenol	274	0.365	1	890	890	860	18,000	
2,4-Dinitrotoluene	292					330	3,600	
2,6-Dinitrotoluene	291					330	3,600	
234678-HxCDF	6	33.3	2	7.81E-04	0.00199	0.00271	0.00474	
23478-PeCDF	6	33.3	2	0.00143	0.00429	0.00271	0.00474	
2378-TCDD	6	16.7	1	0.00278	0.00278	9.04E-04	0.00190	0.00850
2378-TCDF	6	16.7	1	0.00612	0.00612	9.04E-04	0.00190	
2-Butanone	246	15.0	37	2	380	3.89	3,100	84.2
2-Chloronaphthalene	291					330	3,600	

Table A1.2.2
Sitewide Summary Statistics for Analytes in Sediment with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
2-Chlorophenol	291					330	3,600	
2-Chlorotoluene	49					0.680	23	
2-Hexanone	239					2.20	3,100	
2-Methyl-1-propanol	1					100	100	
2-Methylnaphthalene	291	3.09	9	41	2,000	330	3,600	20.2
2-Methylphenol	292	0.342	1	200	200	330	3,600	6,970
2-Nitroaniline	291					860	18,000	
2-Nitrophenol	291					270	3,600	
3,3'-Dichlorobenzidine	283					350	7,100	
3-Nitroaniline	274					860	18,000	
4,4'-DDD	231					3.50	200	4.88
4,4'-DDE	231	0.433	1	4.10	4.10	3.50	200	3.16
4,4'-DDT	231	2.16	5	2.90	18	3.50	200	4.16
4,6-Dinitro-2-methylphenol	280	0.714	2	750	1,100	860	18,000	
4-Bromophenyl-phenylether	291					330	3,600	166
4-Chloro-3-methylphenol	291					330	7,100	
4-Chloroaniline	284					330	7,100	
4-Chlorophenyl-phenyl ether	291					330	3,600	
4-Chlorotoluene	49					0.891	23	
4-Isopropyltoluene	49	2.04	1	39	39	0.990	23	
4-Methyl-2-pentanone	247	0.810	2	3	6	2.78	3,100	
4-Methylphenol	293	3.07	9	47	1,500	330	3,600	12.3
4-Nitroaniline	283					860	18,000	
4-Nitrophenol	289	0.346	1	1,300	1,300	860	18,000	
Acenaphthene	291	14.1	41	24	620	330	2,100	6.71
Acenaphthylene	291					330	2,700	5.87
Acetone	250	20.4	51	3	890	3.79	3,300	
Acetonitrile	1					100	100	
Aldrin	229	1.31	3	0	54	1.80	99	8.25
alpha-BHC	231					1.80	99	43.9
alpha-Chlordane	229	0.873	2	0	0	1.80	990	3.24

Table A1.2.2
Sitewide Summary Statistics for Analytes in Sediment with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
Ametryne	4					50	50	
Anthracene	291	26.1	76	19	970	330	2,100	57.2
Atraton	4					50	50	
Atrazine	5	20	1	120	120	50	410	16.8
Benzene	247	0.405	1	3	3	0.809	1,600	260
Benzo(a)anthracene	291	43.3	126	22	1,400	330	3,600	108
Benzo(a)pyrene	290	36.6	106	23	1,300	330	3,600	150
Benzo(b)fluoranthene	290	38.3	111	25	1,500	330	3,600	
Benzo(g,h,i)perylene	287	25.1	72	35	1,100	330	3,600	13
Benzo(k)fluoranthene	290	29.3	85	31	1,200	330	3,600	240
Benzoic Acid	237	12.7	30	95	2,700	370	18,000	
Benzyl Alcohol	241	0.415	1	41	41	330	7,100	1.35
beta-BHC	231	1.30	3	0	28	1.80	99	93.6
beta-Chlordane	157					1.80	400	3.24
bis(2-Chloroethoxy) methane	291					330	3,600	
bis(2-Chloroethyl) ether	291					330	3,600	
bis(2-Chloroisopropyl) ether	288					330	3,600	
bis(2-ethylhexyl)phthalate	291	52.6	153	1	47,000	330	3,600	24,900
Bromobenzene	49					0.954	23	
Bromochloromethane	49					1.03	23	
Bromodichloromethane	248					0.678	1,600	
Bromoform	248					0.668	1,600	
Bromomethane	248	2.42	6	2	5	1.58	3,100	3.43
Butylbenzylphthalate	291	5.50	16	21	1,700	330	3,600	11,400
Carbazole	50	38	19	20	300	350	1,000	25.2
Carbon Disulfide	249					0.898	1,600	
Carbon Tetrachloride	248	0.806	2	390	440	0.823	1,600	7,890
Chlordane	2					23	94	3.24
Chlorobenzene	246					0.717	1,600	
Chloroethane	248					1.68	3,100	
Chloroform	249	2.01	5	1	2	0.777	1,600	

Table A1.2.2
Sitewide Summary Statistics for Analytes in Sediment with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
Chloromethane	244					1.26	3,100	
Chrysene	292	48.6	142	22	1,500	330	3,600	166
cis-1,2-Dichloroethene	49	2.04	1	48	48	1.05	12	
cis-1,3-Dichloropropene	248					0.814	1,600	
Dalapon	1					2,300	2,300	
delta-BHC	231	1.30	3	0	13	1.80	99	2.37
Dibenz(a,h)anthracene	289	7.61	22	21	530	330	3,600	33
Dibenzofuran	291	3.78	11	20	300	330	3,600	325
Dibromochloromethane	248					0.720	1,600	
Dibromomethane	49					0.752	23	
Dicamba	1					96	96	
Dichlorodifluoromethane	49					1.88	23	
Dichloroprop	1					650	650	
Dieldrin	231	0.433	1	4.60	4.60	3.50	200	5.94
Diethylphthalate	292	1.03	3	25	79	330	3,600	108
Dimethylphthalate	291	1.37	4	75	490	330	3,600	
Di-n-butylphthalate	292	23.3	68	28	390	340	3,600	612
Di-n-octylphthalate	291	7.90	23	21	9,800	330	3,600	
Dinoseb	1					84	84	
Endosulfan I	231	1.30	3	0	20	1.80	99	0.690
Endosulfan II	231					3.50	200	0.690
Endosulfan sulfate	231					3.50	200	0.690
Endrin	231					3.50	200	
Endrin aldehyde	53					3.50	27	
Endrin ketone	221					3.50	200	
Ether	1					10	10	
ethyl acetate	1					10	10	
Ethylbenzene	247	0.810	2	1.40	9	0.657	1,600	16,570
Fluoranthene	292	54.8	160	31	3,100	330	3,600	423
Fluorene	291	9.62	28	21	650	330	3,600	77.4
gamma-BHC (Lindane)	230	0.870	2	4.40	25	1.80	99	2.37

Table A1.2.2
Sitewide Summary Statistics for Analytes in Sediment with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
gamma-Chlordane	72	2.78	2	0	0	3.70	990	3.24
Gasoline	2					600	1,500	
Heptachlor	231	1.30	3	0	3.10	1.80	99	0.132
Heptachlor epoxide	231	1.30	3	0	33	1.80	99	2.47
Heptachlorodibenzo-p-dioxin	6	83.3	5	0.00285	0.0946	0.00419	0.00419	
Hexachlorobenzene	292					330	3,600	
Hexachlorobutadiene	313	0.319	1	2	2	1.13	3,600	23
Hexachlorocyclopentadiene	283					330	3,600	
Hexachloroethane	292					330	3,600	
Indeno(1,2,3-cd)pyrene	288	27.8	80	23	910	330	3,600	17
Isophorone	291					270	3,600	
Isopropylbenzene	49					0.516	23	
MCPA	1					94,000	94,000	
MCPP	1					140,000	140,000	
Methoxychlor	231	0.433	1	2.70	2.70	3.80	990	24
Methylene Chloride	255	21.6	55	2	420	1.02	8,300	
Naphthalene	313	6.39	20	1.10	320	0.815	3,600	176
n-Butanol	1					100	100	
n-Butylbenzene	49					1.02	23	
Nitrobenzene	292					330	3,600	
N-Nitroso-di-n-propylamine	291					330	3,600	
N-nitrosodiphenylamine	291					330	3,600	
n-Propylbenzene	49					0.828	23	
OCDD	6	100	6	0.0133	0.539			
OCDF	6	83.3	5	0.00128	0.0409	0.00838	0.00838	
PCB-1016	313					35	990	40
PCB-1221	313					35	990	40
PCB-1232	313					35	990	40
PCB-1242	313					35	990	40
PCB-1248	313					35	990	40
PCB-1254	317	22.7	72	7.30	5,200	35	2,000	40

Table A1.2.2
Sitewide Summary Statistics for Analytes in Sediment with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
PCB-1260	311	2.25	7	53	2,000	35	2,000	40
Pentachlorodibenzo-p-dioxin	6	16.7	1	3.72E-04	3.72E-04	0.00184	0.00474	
Pentachlorophenol	292	2.05	6	39	1,500	330	18,000	255
Phenanthrene	292	49.7	145	24	3,300	330	3,600	204
Phenol	291	1.72	5	22	150	340	3,600	773
Prometon	4					50	50	
Prometryn	4					50	50	
Propazine	4					50	50	
Pyrene	292	47.6	139	20	3,900	330	3,600	195
Pyridine	76					370	3,600	
sec-Butylbenzene	49					0.786	23	
Simazine	4					50	50	
Simetryn	4					50	50	
Styrene	247					0.874	1,600	
Terbutryn	4					50	50	
Terbutylazine	4					50	50	
tert-Butylbenzene	49					1.05	23	
Tetrachloroethene	247	2.83	7	1	38	1.25	1,600	3,050
Toluene	250	24	60	0.420	860	0.878	1,300	1,660
Toxaphene	231					85	2,300	
trans-1,2-Dichloroethene	49	2.04	1	2	2	1.09	12	657
trans-1,3-Dichloropropene	248					0.923	1,600	
Trichloroethene	248	2.42	6	1.10	48	0.655	1,600	22,800
Trichlorofluoromethane	49	26.5	13	1	5	0.935	23	
Vinyl acetate	148					10	38	
Vinyl Chloride	249	0.402	1	16.8	16.8	2.45	3,100	
Xylene	247	2.02	5	5	68	2.65	1,600	91
Radionuclide (pCi/g)								
Americium-241	462	100	462	-0.0370	56.5	-0.0370	0.164	5,150
Cesium-134	137	100	137	-0.201	0.300	0.00100	0.300	
Cesium-137	226	100	226	-0.00176	1.50	0.00300	0.330	3,120

Table A1.2.2
Sitewide Summary Statistics for Analytes in Sediment with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Number of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
Gross Alpha	259	100	259	-9.70	320			
Gross Beta	264	100	264	4.95	125			
Plutonium-239/240	482	100	482	-0.0160	217	-0.0160	0.192	5,860
Radium-226	113	100	113	-9.84	3.08	0.790	0.790	101
Radium-228	95	100	95	0.0400	4.10	0.810	0.810	87.8
Strontium-89/90	200	100	200	-0.300	4.86	-0.140	0.230	582
Uranium-233/234	424	100	424	0.140	15	0.527	0.527	5,280
Uranium-235	424	100	424	-0.0523	0.852	-0.0523	0.338	3,730
Uranium-238	424	100	424	0	59			2,490

Table A1.2.NNAEU.1

Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Water in the NN AEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESLs	Percent Nondetected Results > PRG	Analyte Detected?
Inorganic (Dissolved) (mg/L)								
Cadmium	8.00E-05	-	0.00460	32	2.50E-04	28	87.5	Yes
Cesium	0.0480	-	0.500	24		0	0	No
Cyanide		-		0	5.00E-04	0	0	No
Mercury	1.40E-05	-	2.00E-04	32	7.70E-04	0	0	No
Ortho-phosphate		-		0		0	0	No
Phosphate		-		0		0	0	No
Sulfide		-		0		0	0	No
Thallium	8.80E-04	-	0.0150	32	0.0150	0	0	Yes
Uranium	0.00550	-	0.00550	1	1.50	0	0	Yes
Inorganic (Total) (mg/L)								
Cadmium	8.00E-05	-	0.00500	59	2.50E-04	34	57.6	Yes
Cesium	0.0330	-	0.500	25		0	0	No
Cyanide	0	-	0.0200	22	5.00E-04	21	95.5	No
Mercury	1.40E-05	-	5.40E-04	55	7.70E-04	0	0	No
Ortho-phosphate	0.0500	-	0.0500	16		0	0	No
Phosphate	0.0200	-	0.0500	3		0	0	No
Sulfide	1	-	1	21		0	0	No
Thallium	5.00E-04	-	0.0120	58	0.0150	0	0	Yes
Uranium	0.00200	-	0.00550	24	1.50	0	0	Yes
Organic (Total) (ug/L)								
1,1,1,2-Tetrachloroethane	0.100	-	10	23		0	0	No
1,1,1-Trichloroethane	0.100	-	5	53	89	0	0	No
1,1,2,2-Tetrachloroethane	0.100	-	5	53	2,400	0	0	No
1,1,2-Trichloro-1,2,2-trifluoroethane	1	-	5	9	32	0	0	No
1,1,2-Trichloroethane	0.100	-	5	53	940	0	0	No
1,1-Dichloroethene	0.200	-	5	53	65	0	0	No
1,1-Dichloropropene	0.100	-	5	22		0	0	No
1,2,3-Trichlorobenzene	0.100	-	5	22	8	0	0	No
1,2,3-Trichloropropane	0.100	-	10	23		0	0	No
1,2,4-Trichlorobenzene	0.100	-	12	35	50	0	0	Yes
1,2,4-Trimethylbenzene	0.100	-	2	22	17	0	0	Yes
1,2-Dibromo-3-chloropropane	1	-	20	20		0	0	No
1,2-Dibromoethane	0.500	-	20	23		0	0	No
1,2-Dichlorobenzene	0.100	-	12	35	13	0	0	No
1,2-Dichloroethane	0.100	-	5	53	20,000	0	0	No
1,2-Dichloropropane	0.100	-	5	53	5,700	0	0	Yes
1,3,5-Trimethylbenzene	0.100	-	5	22	45	0	0	No
1,3-Dichlorobenzene	0.100	-	12	35	28	0	0	No
1,3-Dichloropropane	0.100	-	5	22		0	0	No
1,4-Dichlorobenzene	0.100	-	12	35	16	0	0	No
2,2-Dichloropropane	0.500	-	5	22		0	0	No
2,4,5-T	10	-	10	1		0	0	No
2,4,5-TP (Silvex)	10	-	10	1		0	0	No
2,4,5-Trichlorophenol	10	-	330	23		0	0	No
2,4,6-Trichlorophenol	5	-	330	23	5	18	78.3	No
2,4-D	10	-	10	1		0	0	No
2,4-DB	10	-	10	1		0	0	No
2,4-Dichlorophenol	5	-	330	23	365	0	0	No
2,4-Dinitrophenol	25	-	1,700	23		0	0	No
2,4-Dinitrotoluene	5	-	330	22		0	0	No
2,6-Dinitrotoluene	5	-	330	22		0	0	No
2378-TCDD	5.00E-04	-	5.00E-04	1		0	0	No
2-Butanone	5	-	10	38	2,200	0	0	No
2-Chloronaphthalene	5	-	330	22	630	0	0	No
2-Chlorophenol	5	-	330	23		0	0	No
2-Chlorotoluene	0.200	-	5	22		0	0	No
2-Hexanone	5	-	10	40	99	0	0	No
2-Methyl-1-propanol	2,000	-	2,000	1		0	0	No
2-Methylphenol	5	-	330	23	82	1	4.35	No
2-Nitroaniline	25	-	1,700	22		0	0	No

Table A1.2.NNAEU.1

Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Water in the NN AEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESLs	Percent Nondetected Results > PRG	Analyte Detected?
Inorganic (Dissolved) (mg/L)								
2-Nitrophenol	5	-	330	23		0	0	No
3 & 4-methyl phenol	10	-	10.6	2		0	0	No
3,3'-Dichlorobenzidine	10	-	670	22		0	0	No
3-Nitroaniline	25	-	1,700	22		0	0	No
4,4'-DDD	0.100	-	0.110	7	0.0600	7	100	No
4,4'-DDE	0.100	-	0.110	7	105	0	0	No
4,4'-DDT	0.100	-	0.110	7	0.00100	7	100	No
4,6-Dinitro-2-methylphenol	10	-	1,700	23		0	0	No
4-Bromophenyl-phenylether	3	-	330	22		0	0	Yes
4-Chloro-3-methylphenol	5	-	670	23		0	0	No
4-Chloroaniline	5	-	670	22		0	0	No
4-Chlorophenyl-phenyl ether	5	-	330	22		0	0	No
4-Chlorotoluene	0.200	-	5	22		0	0	No
4-Isopropyltoluene	0.200	-	3	22		0	0	Yes
4-Methyl-2-pentanone	5	-	10	40	170	0	0	No
4-Nitroaniline	25	-	1,700	22		0	0	No
4-Nitrophenol	25	-	1,700	22		0	0	No
Acenaphthylene	2	-	330	22		0	0	Yes
Acetonitrile	100	-	100	1		0	0	No
Acrolein	500	-	500	1		0	0	No
Acrylonitrile	100	-	100	1		0	0	No
Aldrin	0.0500	-	0.0560	7	0.150	0	0	No
Allyl Chloride	10	-	10	1		0	0	No
alpha-Chlordane	0.0500	-	0.560	7		0	0	No
Aniline	10	-	10	1		0	0	No
Anthracene	5	-	330	22	0.730	22	100	No
Atrazine	1	-	1	1	7.30	0	0	No
Benzo(a)anthracene	5	-	330	22	0.0270	22	100	No
Benzo(a)pyrene	5	-	330	22	0.0140	22	100	No
Benzo(b)fluoranthene	5	-	12	20		0	0	No
Benzo(b,k)fluoroanthene	10	-	330	2		0	0	No
Benzo(g,h,i)perylene	5	-	330	22		0	0	No
Benzo(k)fluoranthene	5	-	12	20		0	0	No
Benzoic Acid	25	-	1,700	20	42	15	75	No
Benzyl Alcohol	5	-	670	23	8.60	18	78.3	No
beta-Chlordane	0.0500	-	0.0500	2		0	0	No
bis(2-Chloroethoxy) methane	5	-	330	22		0	0	No
bis(2-Chloroethyl) ether	5	-	330	22		0	0	No
bis(2-Chloroisopropyl) ether	5	-	330	22	29	1	4.55	No
Bromobenzene	0.200	-	5	22		0	0	No
Bromochloromethane	0.500	-	5	22		0	0	No
Bromodichloromethane	0.200	-	5	53	1,100	0	0	No
Bromoform	0.100	-	5	53	320	0	0	Yes
Bromomethane	1	-	10	53	35	0	0	No
Butylbenzylphthalate	0.700	-	330	22	67	1	4.55	Yes
Carbon Disulfide	1	-	5	40	0.920	40	100	No
Carbon Tetrachloride	0.200	-	5	53	3,520	0	0	No
Chlorobenzene	0.100	-	5	53	47	0	0	No
Chloroform	0.100	-	5	53	1,240	0	0	No
Chloromethane	0.500	-	10	53		0	0	Yes
Chrysene	5	-	330	22		0	0	No
cis-1,2-Dichloroethene	0.100	-	5	22	620	0	0	No
cis-1,3-Dichloropropene	0.100	-	5	53	244	0	0	No
Dalapon	10	-	10	1		0	0	No
Dibenz(a,h)anthracene	5	-	330	22		0	0	No
Dibromochloromethane	0.200	-	5	53		0	0	No
Dibromomethane	0.500	-	20	23		0	0	No
Dicamba	10	-	10	1	10	0	0	No
Dichlorodifluoromethane	0.500	-	20	23		0	0	No
Dichloroprop	10	-	10	1		0	0	No

Table A1.2.NNAEU.1
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Water in the NN AEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESLs	Percent Nondetected Results > PRG	Analyte Detected?
Inorganic (Dissolved) (mg/L)								
Dieldrin	0.100	-	0.110	7	0.0560	7	100	No
Dimethylphthalate	5	-	330	22		0	0	No
Di-n-octylphthalate	5	-	330	22		0	0	No
Dinoseb	10	-	10	1	0.480	1	100	No
Diphenylamine	10.6	-	10.6	1		0	0	No
Endosulfan I	0.0500	-	0.0560	7	0.0560	0	0	No
Endosulfan II	0.100	-	0.110	7	0.0560	7	100	No
Endosulfan sulfate	0.100	-	0.110	7	0.0560	7	100	No
Endrin	0.100	-	0.110	7	0.0360	7	100	No
Endrin aldehyde	0.100	-	0.100	2	0.0360	2	100	No
Endrin ketone	0.100	-	0.110	7	0.0360	7	100	No
Ethyl Methacrylate	20	-	20	1		0	0	No
Fluoranthene	5	-	330	22	398	0	0	No
gamma-Chlordane	0.500	-	0.560	5		0	0	No
Heptachlor epoxide	0.0500	-	0.0560	7	0.00380	7	100	No
Hexachlorobenzene	5	-	330	22		0	0	No
Hexachlorobutadiene	0.100	-	12	35	9.30	11	31.4	No
Hexachlorocyclopentadiene	5	-	330	22		0	0	No
Hexachlorodibenzofuran	2.00E-04	-	2.00E-04	1		0	0	No
Hexachlorodibenzo-p-dioxin	4.00E-04	-	4.00E-04	1		0	0	No
Hexachloroethane	5	-	330	22	540	0	0	No
Indeno(1,2,3-cd)pyrene	5	-	330	22		0	0	No
Iodomethane	10	-	10	1		0	0	No
Isophorone	0.200	-	330	22	1,300	0	0	Yes
Isopropylbenzene	0.200	-	5	22		0	0	No
m,p-Xylene	0.200	-	1	5	35	0	0	No
MCPA	10,000	-	10,000	1		0	0	No
MCPP	10,000	-	10,000	1		0	0	No
Methoxychlor	0.500	-	0.560	7		0	0	No
Methyl Acrylonitrile	20	-	20	1		0	0	No
methyl methacrylate	20	-	20	1		0	0	No
n-Butylbenzene	0.200	-	5	22		0	0	No
Nitrobenzene	5	-	330	22		0	0	No
N-Nitroso-di-n-propylamine	5	-	330	22		0	0	No
N-nitrosodiphenylamine	5	-	330	21		0	0	No
n-Propylbenzene	0.200	-	5	22		0	0	No
o-Xylene	0.200	-	1	6	35	0	0	No
PCB-1016	0.500	-	1	7	0.0140	7	100	No
PCB-1221	0.500	-	2	7	0.0140	7	100	No
PCB-1232	0.500	-	1	7	0.0140	7	100	No
PCB-1242	0.500	-	1	7	0.0140	7	100	No
PCB-1248	0.500	-	1	7	0.0140	7	100	No
PCB-1254	1	-	1.10	7	0.0140	7	100	No
PCB-1260	1	-	1.10	7	0.0140	7	100	No
Pentachlorodibenzofuran	5.00E-04	-	5.00E-04	1		0	0	No
Pentachlorodibenzo-p-dioxin	0.00100	-	0.00100	1		0	0	No
Pentachloroethane	20	-	20	1		0	0	No
Pentachlorophenol	4	-	1,700	23	6.73	22	95.7	Yes
Pyrene	2	-	330	22	0.0250	22	100	Yes
sec-Butylbenzene	0.200	-	5	22		0	0	No
Simazine	1	-	1	1	10	0	0	No
Styrene	0.100	-	5	53	160	0	0	No
TCDF	7.00E-04	-	7.00E-04	1		0	0	No
tert-Butylbenzene	0.200	-	5	22		0	0	No
Tetrachlorodibenzo-p-dioxin	5.00E-04	-	5.00E-04	1		0	0	No
Tetrachloroethene	0.100	-	5	53	840	0	0	No
Toxaphene	1	-	5	7		0	0	No
trans-1,2-Dichloroethene	0.100	-	5	22	1,500	0	0	No
trans-1,3-Dichloropropene	0.100	-	5	53	244	0	0	No
trans-1,4-Dichlorobutene-2	20	-	20	1		0	0	No

Table A1.2.NNAEU.1
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Water in the NN AEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESLs	Percent Nondetected Results > PRG	Analyte Detected?
Inorganic (Dissolved) (mg/L)								
Tributyl phosphate	106	-	106	1		0	0	No
Trichloroethene	0.100	-	5	53	21,900	0	0	Yes
Trichlorofluoromethane	0.500	-	10	23		0	0	No
Vinyl acetate	10	-	10	30		0	0	No
Vinyl Chloride	0.200	-	11	53	930	0	0	Yes

Table A1.2.NN AEU.2
Summary of Professional Judgment and Ecological Risk Potential for Analytes in Surface Water for the NN AEU

ANALYTE	SUMMARY OF PROFESSIONAL JUDGMENT												ECOLOGICAL RISK POTENTIAL							
	Listed as Waste Constituent for NN AEU Historical IHSSs ?[1]	Historical RFETS Inventory [2] (1974/1988) (kg)	MDC in NN AEU Surface Soil (µg/kg)	Percent Detects in NN AEU Surface Soil (µg/kg)	MDC in NN AEU Sediment (µg/kg)	Percent Detects in NN AEU Sediment (%)	MDC in NN AEU Surface Water (µg/L)	Percent Detects in NN AEU Surface Water (%)	MDC in Surface Water Sitewide (µg/L)	Detection Frequency in Sitewide Surface Water (%)	Potential to be an ECOPC?	Uncertainty Category[3]	ESL (µg/L) [4]	Acute Effects Value[5]	Maximum Reported Result for Non-Detects in NN AEU (µg/kg)	Maximum Reported Result for Non-Detects/ ESL[6]	Potential for Chronic Effects if Detected at Maximum Reported Results Level?	Maximum Reported Result for Non-Detects/ Acute Effects Value[6]	Potential for Acute Effects if Detected at Maximum Reported Results Level?
cadmium (dissolved)[7]	No	100/44	12.3	26	0.16	10.00	0.00052	5.1	0.0483	35	Yes	3	0.00025	0.005	0.0046	20	Yes	0.90	No
cadmium (total)[7]	No	100/44	12.3	26	0.16	10.00	0.00052	5.1	0.0483	35	Yes	3	0.00025	0.005	0.005	20	Yes	1	No
Cyanide[7]	No	.06/.43	NA	0	NS	0.00	NA	0	0.026	4.8	No	1	0.0005	0.005	0.02	40	Yes	4	Yes
2,4,6-trichlorophenol	No	0/.01	NA	0	ND	0.00	NA	0	NA	0	No	1	5	79	330	70	Yes	4	Yes
4,4'-DDD	No	0/.001	NA	0	ND	0.00	NA	0	0.1	0.6	No	2	0.06	0.6	0.11	2	Yes	0.20	No
4,4'-DDT	No	0/.001	26	1.5	ND	0.00	NA	0	0.6	3.5	Yes	3	0.001	NVA	0.11	100	Yes	No AEV	I
anthracene	No	.5/.02	650	30	51	12.50	NA	0	2	0.2	Yes	3	0.7	13	330	500	Yes	20	Yes
benzo(a)anthracene	No	0/0	1100	56	150	37.50	NA	0	8	0.2	Yes	3	0.027	0.49	330	10000	Yes	700	Yes
benzo(a)pyrene	No	0/.002	1000	52	160	12.50	NA	0	9	0.2	Yes	3	0.014	0.24	330	20000	Yes	1000	Yes
benzoic acid	No	0/0	530	28	ND	0.00	NA	0	42	1.5	Yes	3	42	740	1700	40	Yes	2	Yes
benzyl alcohol	No	.02/.02	NA	0	ND	0.00	NA	0	860	1.8	No	2	8.6	150	670	80	Yes	4	Yes
carbon disulfide	No	3.3/5.9	NA	0	ND	0.00	NA	0	8	0.3	No	2	0.92	17	5	5	Yes	0.30	No
dieldrin	No	0/.003	NA	0	ND	0.00	NA	0	NA	0	No	1	0.056	0.24	0.11	2	Yes	0.50	No
dinoseb	No	0/0	NA	0	NS	0.00	NA	0	0.3	2.2	No	2	0.48	9.5	10	20	Yes	1	No
endosulfan II	No	0/.001	NA	0	ND	0.00	NA	0	NA	0	No	1	0.056	NVA	0.11	2	Yes	No AEV	I
endosulfan sulfate	No	0/.001	NA	0	ND	0.00	NA	0	NA	0	No	1	0.056	NVA	0.11	2	Yes	No AEV	I
endrin	No	0/.004	NA	0	ND	0.00	NA	0	0.02	0.3	No	2	0.036	0.086	0.11	3	Yes	1	No
endrin aldehyde	No	0/.002	NA	0	NS	0.00	NA	0	NA	0	No	1	0.036	NVA	0.11	3	Yes	No AEV	I
endrin ketone	No	0/0	NA	0	ND	0.00	NA	0	NA	0	No	1	0.036	NVA	0.11	3	Yes	No AEV	I
heptachlor epoxide	No	0/.001	23	1.5	ND	0.00	NA	0	0.05	0.3	Yes	3	0.0038	0.52	0.056	20	Yes	0.10	No
PCB-1016	No	0/.006	NA	0	ND	0.00	NA	0	NA	0	No	1	0.014	2	1	70	Yes	0.50	No
PCB-1221	No	0/.02	NA	0	ND	0.00	NA	0	NA	0	No	1	0.014	2	2	100	Yes	1	No
PCB-1232	No	0/.007	NA	0	ND	0.00	NA	0	NA	0	No	1	0.014	2	1	70	Yes	0.50	No
PCB-1242	No	0/.02	NA	0	ND	0.00	NA	0	NA	0	No	1	0.014	2	1	70	Yes	0.50	No
PCB-1248	No	0/.007	NA	0	ND	0.00	NA	0	NA	0	No	1	0.014	2	1	70	Yes	0.50	No
PCB-1254	No	0/.017	3400	15	ND	0	NA	0	24	2.3	Yes	3	0.014	2	1.1	80	Yes	0.50	No
PCB-1260	No	0/.02	680	15	ND	0	NA	0	NA	0	Yes	3	0.014	2	1.1	80	Yes	0.50	No
pentachlorophenol	No	.02/.02	39	1.1	ND	0	4	4.3	5	0.4	Yes	3	6.7	17.4	1700	300	Yes	100	Yes
pyrene	No	.02/.02	2600	85	320	12.5	2	4.5	12	1.3	Yes	4	0.025	NVA	330	10000	Yes	No AEV	I

[1] Includes listing of the class of compound, e.g., herbicides, pesticides, chlorinated solvents, polynuclear aromatic hydrocarbons, etc. Ref. DOE, 2005b.
[2] CDH, 1991.
[3] See text for explanation.
[4] ESLs based on chronic effects value.
[5] Chronic and acute effects values are listed in Appendix B, Table B-5, "Surface Water ESLs for Aquatic Receptors", Ref. DOE 2005a.
[6] Ratios are rounded to the one significant figure.
[7] Units - mg/L for water and mg/kg for soil/sediment.
Shaded entries are analytes that have both a potential to be an ECOPC and a potential for acute effects if detected at the maximum reported results level.
CDH – Colorado Department of Health
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
DOE – Department of Energy
ESL – Ecological Screening Level
IHSS – Individual Hazardous Substance Site
MDC - Maximum Detected Concentration
NN AEU – No Name Gulch Aquatic Exposure Unit
RFETS – Rocky Flats Environmental Technology Site

I - Inconclusive
NA – Not applicable
ND - Not detected
NS - Not sampled
No ESL – No chronic ESL available
No AEV – No acute effects level available
NVA - No value

Table A1.2.NNAEU.3
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Sediment in the NN AEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > PRG	Analyte Detected?
Inorganic (mg/kg)								
Antimony	0.590	-	14.7	19	2	9	47.4	No
Uranium	1	-	1.40	10		0	0	No
Organic (ug/kg)								
1,1,1,2-Tetrachloroethane	5.80	-	7.80	10		0	0	No
1,1,1-Trichloroethane	5	-	9	16	159	0	0	No
1,1,2,2-Tetrachloroethane	5	-	9	16	1,900	0	0	No
1,1,2-Trichloro-1,2,2-trifluoroethane	5.80	-	7.80	10		0	0	No
1,1,2-Trichloroethane	5	-	9	16		0	0	No
1,1-Dichloroethane	5	-	9	16		0	0	No
1,1-Dichloroethene	5	-	9	16		0	0	No
1,1-Dichloropropene	5.80	-	7.80	10		0	0	No
1,2,3-Trichlorobenzene	5.80	-	7.80	10	58.6	0	0	No
1,2,3-Trichloropropane	5.80	-	7.80	10		0	0	No
1,2,4-Trichlorobenzene	5.80	-	500	16	429	2	12.5	No
1,2-Dibromo-3-chloropropane	5.80	-	7.80	10		0	0	No
1,2-Dibromoethane	5.80	-	7.80	10		0	0	No
1,2-Dichlorobenzene	5.80	-	500	16		0	0	No
1,2-Dichloroethane	5	-	9	16		0	0	No
1,2-Dichloroethene	5	-	9	6		0	0	No
1,2-Dichloropropane	5	-	9	16		0	0	No
1,3,5-Trimethylbenzene	5.80	-	7.80	10	316	0	0	No
1,3-Dichlorobenzene	5.80	-	500	16	122	6	37.5	No
1,3-Dichloropropane	5.80	-	7.80	10		0	0	No
1,4-Dichlorobenzene	5.80	-	500	16		0	0	No
2,2-Dichloropropane	5.80	-	7.80	10		0	0	No
2,4,5-Trichlorophenol	760	-	2,400	16		0	0	No
2,4,6-Trichlorophenol	340	-	1,000	16	59.3	16	100	No
2,4-Dichlorophenol	340	-	1,000	16		0	0	No
2,4-Dimethylphenol	340	-	1,000	16		0	0	No
2,4-Dinitrophenol	1,700	-	5,100	14		0	0	No
2,4-Dinitrotoluene	340	-	1,000	16		0	0	No
2,6-Dinitrotoluene	340	-	1,000	16		0	0	No
2-Chloronaphthalene	340	-	1,000	16		0	0	No
2-Chlorophenol	340	-	1,000	16		0	0	No
2-Chlorotoluene	5.80	-	7.80	10		0	0	No
2-Hexanone	10	-	31	16		0	0	No
2-Methylnaphthalene	340	-	1,000	16	20.2	16	100	No
2-Methylphenol	340	-	1,000	16	6,970	0	0	No
2-Nitroaniline	1,700	-	5,100	16		0	0	No
2-Nitrophenol	340	-	1,000	16		0	0	No
3,3'-Dichlorobenzidine	680	-	2,000	15		0	0	No
3-Nitroaniline	1,700	-	5,100	15		0	0	No
4,4'-DDD	16	-	24	6	4.88	6	100	No
4,4'-DDE	16	-	24	6	3.16	6	100	No
4,4'-DDT	16	-	24	6	4.16	6	100	No
4,6-Dinitro-2-methylphenol	1,700	-	5,100	14		0	0	No
4-Bromophenyl-phenylether	340	-	1,000	16	166	16	100	No
4-Chloro-3-methylphenol	340	-	2,000	16		0	0	No
4-Chloroaniline	340	-	2,000	16		0	0	No
4-Chlorophenyl-phenyl ether	340	-	1,000	16		0	0	No
4-Chlorotoluene	5.80	-	7.80	10		0	0	No
4-Isopropyltoluene	5.80	-	7.80	10		0	0	No
4-Methyl-2-pentanone	10	-	31	16		0	0	No
4-Methylphenol	340	-	1,000	16	12.3	16	100	No
4-Nitroaniline	1,700	-	5,100	16		0	0	No

Table A1.2.NNAEU.3

Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Sediment in the NN AEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > PRG	Analyte Detected?
Inorganic (mg/kg)								
4-Nitrophenol	1,700	-	5,100	16		0	0	No
Acenaphthene	340	-	510	16	6.71	16	100	No
Acenaphthylene	340	-	510	16	5.87	16	100	No
Aldrin	8	-	12	6	8.25	5	83.3	No
alpha-BHC	8	-	12	6	43.9	0	0	No
alpha-Chlordane	80	-	120	6	3.24	6	100	No
Benzene	5	-	9	16	260	0	0	No
Benzoic Acid	1,700	-	5,100	15		0	0	No
Benzyl Alcohol	340	-	2,000	16	1.35	16	100	No
beta-BHC	8	-	12	6	93.6	0	0	No
beta-Chlordane	110	-	120	2	3.24	2	100	No
bis(2-Chloroethoxy) methane	340	-	1,000	16		0	0	No
bis(2-Chloroethyl) ether	340	-	1,000	16		0	0	No
bis(2-Chloroisopropyl) ether	340	-	1,000	16		0	0	No
Bromobenzene	5.80	-	7.80	10		0	0	No
Bromochloromethane	5.80	-	7.80	10		0	0	No
Bromodichloromethane	5	-	9	16		0	0	No
Bromoform	5	-	9	16		0	0	No
Bromomethane	5.80	-	18	16	3.43	16	100	No
Butylbenzylphthalate	340	-	1,000	16	11,400	0	0	No
Carbon Disulfide	5	-	9	16		0	0	No
Carbon Tetrachloride	5	-	9	16	7,890	0	0	No
Chlorobenzene	5	-	9	16		0	0	No
Chloroethane	5.80	-	18	16		0	0	No
Chloroform	5	-	9	16		0	0	No
Chloromethane	5.80	-	13	15		0	0	No
cis-1,2-Dichloroethene	2.90	-	3.90	10		0	0	No
cis-1,3-Dichloropropene	5	-	9	16		0	0	No
delta-BHC	8	-	12	6	2.37	6	100	No
Dibenz(a,h)anthracene	340	-	1,000	16	33	16	100	No
Dibenzofuran	340	-	1,000	16	325	16	100	No
Dibromochloromethane	5	-	9	16		0	0	No
Dibromomethane	5.80	-	7.80	10		0	0	No
Dichlorodifluoromethane	5.80	-	7.80	10		0	0	No
Dieldrin	16	-	24	6	5.94	6	100	No
Diethylphthalate	340	-	1,000	16	108	16	100	No
Dimethylphthalate	340	-	1,000	16		0	0	No
Di-n-octylphthalate	340	-	1,000	16		0	0	No
Endosulfan I	8	-	12	6	0.690	6	100	No
Endosulfan II	16	-	24	6	0.690	6	100	No
Endosulfan sulfate	16	-	24	6	0.690	6	100	No
Endrin	16	-	24	6		0	0	No
Endrin ketone	16	-	24	6		0	0	No
Ethylbenzene	5	-	9	16	16,570	0	0	No
Fluorene	340	-	1,000	16	77.4	16	100	No
gamma-BHC (Lindane)	8	-	12	6	2.37	6	100	No
gamma-Chlordane	80	-	97	4	3.24	4	100	No
Heptachlor	8	-	12	6	0.132	6	100	No
Heptachlor epoxide	8	-	12	6	2.47	6	100	No
Hexachlorobenzene	340	-	1,000	16		0	0	No
Hexachlorobutadiene	5.80	-	500	16	23	6	37.5	No
Hexachlorocyclopentadiene	340	-	1,000	14		0	0	No
Hexachloroethane	340	-	1,000	16		0	0	No
Isophorone	340	-	1,000	16		0	0	No
Isopropylbenzene	5.80	-	7.80	10		0	0	No

Table A1.2.NNAEU.3
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Sediment in the NN AEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > PRG	Analyte Detected?
Inorganic (mg/kg)								
Methoxychlor	80	-	120	6	24	6	100	No
n-Butylbenzene	5.80	-	7.80	10		0	0	No
Nitrobenzene	340	-	1,000	16		0	0	No
N-Nitroso-di-n-propylamine	340	-	1,000	16		0	0	No
N-nitrosodiphenylamine	340	-	1,000	16		0	0	No
n-Propylbenzene	5.80	-	7.80	10		0	0	No
PCB-1016	80	-	120	6	40	6	100	No
PCB-1221	80	-	120	6	40	6	100	No
PCB-1232	80	-	120	6	40	6	100	No
PCB-1242	80	-	120	6	40	6	100	No
PCB-1248	80	-	120	6	40	6	100	No
PCB-1254	160	-	240	6	40	6	100	No
PCB-1260	160	-	240	6	40	6	100	No
Pentachlorophenol	1,700	-	5,100	16	255	16	100	No
Phenol	340	-	1,000	16	773	9	56.3	No
Pyridine	760	-	1,000	10		0	0	No
sec-Butylbenzene	5.80	-	7.80	10		0	0	No
Styrene	5	-	9	16		0	0	No
tert-Butylbenzene	5.80	-	7.80	10		0	0	No
Tetrachloroethene	5	-	9	16	3,050	0	0	No
Toxaphene	160	-	240	6		0	0	No
trans-1,2-Dichloroethene	2.90	-	3.90	10	657	0	0	No
trans-1,3-Dichloropropene	5	-	9	16		0	0	No
Trichloroethene	5	-	9	16	22,800	0	0	No
Trichlorofluoromethane	5.80	-	7.80	10		0	0	No
Vinyl acetate	10	-	18	6		0	0	No
Vinyl Chloride	5.80	-	18	16		0	0	No
Xylene	5	-	9	16	91	0	0	No

Table A1.2NNAEU.4
Summary of Professional Judgment and Ecological Risk Potential for Analytes in Sediment for the NN AEU

ANALYTE	SUMMARY OF PROFESSIONAL JUDGMENT										ECOLOGICAL RISK POTENTIAL				
	Listed as Waste Constituent for NN AEU Historical IHSSs ?[1]	Historical RFETS Inventory [2] (1974/1988) (kg)	MDC NN AEU Surface Soil (ug/kg)	Percent Detects in NN AEU Surface Soil (%)	MDC in NN AEU Sediment (ug/kg)	Percent Detects in NN AEU Sediment (%)	MDC in Sediment Sitewide (ug/kg)	Percent Detects in Sitewide Sediment (%)	Potential to be an ECOPC?	Uncertainty Category[3]	ESL[4] (ug/kg)	LOEC[5]	Maximum Reported Result for Non-detects in NN AEU (ug/kg)	Maximum Reported Result/ LOEC[6]	Potential for Adverse Effects if Detected at Reported Results Levels?
2,4-dichlorophenol	No	.02/.02	NA	0	NA	0	NA	0	No	1	NVA	NVA	1000	NA	I
2-methylnaphthalene	No	0/.110	200	1.1	NA	0	2000	3.1	Yes	3	20.2	201	1000	5	Yes
4,4'DDD	No	0/.001	NA	0	NA	0	4.1	0.4	No	2	4.88	NVA	24	NA	I
4,4'DDE	No	0/.001	NA	0	NA	0	18	2.2	No	2	3.16	NVA	24	NA	I
4,4'DDT	No	0/.001	26	1.5	NA	0	18	2.2	Yes	3	4.16	62.9	24	0.4	No
4-bromophenyl-phenylether	No	0/.005	NA	0	NA	0	NA	0	No	1	166	NVA	1000	NA	I
4-methylphenol	No	0/.02	NA	0	NA	0	1500	3.1	No	2	12.3	670	1000	2	Yes
acenaphthene	No	.02/.02	800	23	NA	0	620	14	Yes	3	6.71	89	510	6	Yes
acenaphthylene	No	.02/.02	38	1.1	NA	0	NA	0	Yes	3	5.87	NVA	510	NA	I
aldrin	No	0/.003	NA	0	NA	0	54	1.3	No	2	8.25	NVA	12	NA	I
alpha-chlordane	No	0/0	NA	0	NA	0	NA	0	No	1	3.24	NVA	120	NA	I
benzyl alcohol	No	.02/.02	NA	0	NA	0	41	0.4	No	2	1.35	NVA	2000	NA	I
beta-chlordane	No	0/0	NA	0	NA	0	NA	0	No	1	3.24	NVA	120	NA	I
bromomethane	No	NVA	NA	0	NA	0	5	2.4	No	2	3.43	NVA	18	NA	I
delta-BHC	No	0/0	NA	0	NA	0	13	1.3	No	2	2.37	NVA	12	NA	I
dbenz(a,h)anthracene	No	0/.005	110	4.5	NA	0	530	7.6	Yes	3	33	240	1000	4	Yes
dibenzofuran	No	.02/.01	350	4.5	NA	0	300	3.8	Yes	3	325	NVA	1000	NA	I

Table A1.2NNAEU.4
Summary of Professional Judgment and Ecological Risk Potential for Analytes in Sediment for the NN AEU

Analyte	Summary of Professional Judgment										Ecological Risk Potential				
	Listed as Waste Constituent for NN AEU Historical IHSSs ?[1]	Historical RFETS Inventory [2] (1974/1988) (kg)	MDC NN AEU Surface Soil (ug/kg)	Percent Detects in NN AEU Surface Soil (%)	MDC in NN AEU Sediment (ug/kg)	Percent Detects in NN AEU Sediment (%)	MDC in Sediment Sitewide (ug/kg)	Percent Detects in Sitewide Sediment (%)	Potential to be an ECOPC?	Uncertainty Category[3]	ESL[4] (ug/kg)	LOEC [5]	Maximum Reported Result for Non-detects in NN AEU (ug/kg)	Maximum Reported Result/ LOEC[6]	Potential for Adverse Effects if Detected at Reported Results Levels?
dieldrin	No	0/.003	NA	0	NA	0	4.6	0.4	No	2	5.94	NVA	24	NA	I
diethylphthalate	No	0/.03	93	2.3	NA	0	79	1.0	Yes	3	108	NVA	1000	NA	I
endosulfan I	No	0/.001	NA	0	NA	0	20	1.3	No	2	0.69	NVA	12	NA	I
endosulfan II	No	0/.001	NA	0	NA	0	NA	0	No	1	0.69	NVA	24	NA	I
endosulfan sulfate	No	0/.002	NA	0	NA	0	NA	0	No	1	0.69	NVA	24	NA	I
fluorene	No	.02/.015	680	19	NA	0	650	9.6	Yes	3	77.4	536	1000	2	Yes
gamma-BHC (lindane)	No	0/.002	NA	0	NA	0	25	0.9	No	2	2.37	NVA	12	NA	I
gamma-chlordane	No	0/.003	NA	0	NA	0	NA	0	No	1	3.24	NVA	97	NA	I
heptachlor	No	0/.003	NA	0	NA	0	3.1	1.3	No	2	0.132	16	12	0.8	No
heptachlor epoxide	No	0/.001	23	1.5	NA	0	33	1.3	Yes	3	2.47	16	12	0.8	No
methoxychlor	No	0/.002	NA	0	NA	0	2.7	0.4	No	2	24	NVA	120	NA	I
naphthalene	No	1.8/.922	690	5.4	2.5	19	320	6.4	Yes	3	176	561	120	0.2	No
PCB-1016	No	0/.006	NA	0	NA	0	NA	0	No	1	40	NVA	120	NA	I
PCB-1221	No	0/.02	NA	0	NA	0	NA	0	No	1	40	NVA	120	NA	I
PCB-1232	No	0/.007	NA	0	NA	0	NA	0	No	1	40	NVA	120	NA	I
PCB-1242	No	0/.02	NA	0	NA	0	NA	0	No	1	40	NVA	120	NA	I
PCB-1248	No	0/.007	NA	0	NA	0	NA	0	No	1	40	NVA	120	NA	I
PCB-1254	No	0/.017	3400	15	NA	0	5200	23	Yes	3	40	300	240	0.8	No

Table A1.2NNAEU.4
Summary of Professional Judgment and Ecological Risk Potential for Analytes in Sediment for the NN AEU

ANALYTE	SUMMARY OF PROFESSIONAL JUDGMENT										ECOLOGICAL RISK POTENTIAL				
	Listed as Waste Constituent for NN AEU Historical IHSSs ?[1]	Historical RFETS Inventory [2] (1974/1988) (kg)	MDC NN AEU Surface Soil (ug/kg)	Percent Detects in NN AEU Surface Soil (%)	MDC in NN AEU Sediment (ug/kg)	Percent Detects in NN AEU Sediment (%)	MDC in Sediment Sitewide (ug/kg)	Percent Detects in Sitewide Sediment (%)	Potential to be an ECOPC?	Uncertainty Category[3]	ESL[4] (ug/kg)	LOEC [5]	Maximum Reported Result for Non-detects in NN AEU (ug/kg)	Maximum Reported Result/ LOEC[6]	Potential for Adverse Effects if Detected at Reported Results Levels?
PCB-1260	No	0/.018	680	15	NA	0	2000	2.3	Yes	3	40	NVA	240	NA	I
pentachlorophenol	No	.02/.02	39	1.1	NA	0	1500	2.1	Yes	3	255	360	5100	10	Yes
phenol	No	.02/.01	NA	0	NA	0	150	1.7	No	2	773	NVA	1000	NA	I

[1] Includes listing of the class of compound, e.g., herbicides, pesticides, chlorinated solvents, polynuclear aromatic hydrocarbons, etc. Ref. DOE, 2005b.
[2] CDH, 1991.
[3] See text for explanation.
[4] Basis for the NOEC.
[5] LOECs developed as described in Attachment 5 to Appendix A, Volumes 15B1 and 15B2 of the RI/FS report.
[6] Ratio is rounded to one significant figure.

CDH – Colorado Department of Health
DDD – dichlorodiphenyldichloroethane
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
DOE – Department of Energy
ESL – Ecological Screening Level
IHSS – Individual Hazardous Substance Site
LOEC –Lowest Observed Effect Concentration
MDC – Maximum Detected Concentration
NOEC - No Observed Effect Concentration
NN AEU – No Name Gulch Aquatic Exposure Unit
PCB – Polychlorinated Biphenyl
RFETS – Rocky Flats Environmental Technology Site

I - Inconclusive
NA – Not applicable
NVA – No value available

Table A1.2.RCAEU.1
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Water in the RC AEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Inorganics (Dissolved) (mg/L)								
Beryllium	1.00E-04	-	0.00180	42	0.00240	0	0	No
Boron		-		0	1.90	0	0	No
Mercury	1.00E-04	-	0.00477	41	7.70E-04	1	2.44	Yes
Nitrite		-		0	4.47	0	0	Yes
Silver	1.00E-04	-	0.00680	42	3.20E-04	39	92.9	Yes
Sulfide	1	-	1	1		0	0	No
Thallium	1.00E-04	-	0.00380	40	0.0150	0	0	Yes
Tin	0.00100	-	0.136	39	0.0730	1	2.56	No
Inorganics (Total) (mg/L)								
Beryllium	2.00E-05	-	0.00370	109	0.00240	3	2.75	No
Boron	0.0130	-	0.0130	3	1.90	0	0	No
Mercury	1.30E-05	-	4.80E-04	104	7.70E-04	0	0	Yes
Nitrite	0.0200	-	0.100	32	4.47	0	0	Yes
Silver	4.00E-05	-	0.00680	110	3.20E-04	64	58.2	Yes
Sulfide	1	-	16	33		0	0	No
Thallium	1.00E-04	-	0.00800	110	0.0150	0	0	Yes
Tin	5.20E-04	-	0.136	99	0.0730	1	1.01	No
Organics (Total) (ug/L)								
1,1,1,2-Tetrachloroethane	0.500	-	1	9		0	0	No
1,1,1-Trichloroethane	0.500	-	5	43	89	0	0	No
1,1,2,2-Tetrachloroethane	0.500	-	5	43	2,400	0	0	No
1,1,2-Trichloro-1,2,2-trifluoroethane	1	-	1	1	32	0	0	No
1,1,2-Trichloroethane	0.500	-	5	43	940	0	0	No
1,1-Dichloroethane	0.500	-	5	43	740	0	0	No
1,1-Dichloroethene	0.500	-	5	43	65	0	0	No
1,1-Dichloropropene	0.500	-	1	9		0	0	No
1,2,3-Trichlorobenzene	0.500	-	1	9	8	0	0	No
1,2,3-Trichloropropane	1	-	1	9		0	0	No
1,2,4-Trichlorobenzene	0.500	-	10	12	50	0	0	No
1,2,4-Trimethylbenzene	0.500	-	1	9	17	0	0	No
1,2-Dibromo-3-chloropropane	1	-	1	9		0	0	No
1,2-Dibromoethane	0.500	-	1	9		0	0	No
1,2-Dichlorobenzene	0.500	-	10	12	13	0	0	No
1,2-Dichloroethane	0.500	-	5	43	20,000	0	0	No
1,2-Dichloroethene	5	-	5	34	1,100	0	0	No
1,2-Dichloropropane	0.500	-	5	43	5,700	0	0	No
1,3,5-Trimethylbenzene	0.500	-	1	9	45	0	0	No
1,3-Dichlorobenzene	0.500	-	10	12	28	0	0	No
1,3-Dichloropropane	0.500	-	1	9		0	0	No
1,4-Dichlorobenzene	0.500	-	10	12	16	0	0	No
2,2-Dichloropropane	0.500	-	1	9		0	0	No
2,4,5-Trichlorophenol	50	-	52	3		0	0	No
2,4,6-Trichlorophenol	10	-	10	3	5	3	100	No
2,4-Dichlorophenol	10	-	10	3	365	0	0	No
2,4-Dimethylphenol	10	-	10	3	212	0	0	No
2,4-Dinitrophenol	50	-	52	3		0	0	No
2,4-Dinitrotoluene	10	-	10	3		0	0	No
2,6-Dinitrotoluene	10	-	10	3		0	0	No
2-Butanone	10	-	10	32	2,200	0	0	No
2-Chloronaphthalene	10	-	10	3	630	0	0	No
2-Chlorophenol	10	-	10	3		0	0	No
2-Chlorotoluene	0.500	-	1	9		0	0	No
2-Hexanone	10	-	10	35	99	0	0	No
2-Methylnaphthalene	10	-	10	3		0	0	No
2-Methylphenol	10	-	10	3	82	0	0	No

Table A1.2.RCAEU.1
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Water in the RC AEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
2-Nitroaniline	50	-	52	3		0	0	No
2-Nitrophenol	10	-	10	3		0	0	No
3,3'-Dichlorobenzidine	20	-	21	3		0	0	No
3-Nitroaniline	50	-	52	3		0	0	No
4,4'-DDD	0.100	-	0.100	3	0.0600	3	100	No
4,4'-DDE	0.100	-	0.100	3	105	0	0	No
4,4'-DDT	0.100	-	0.100	3	0.00100	3	100	No
4,6-Dinitro-2-methylphenol	50	-	52	3		0	0	No
4-Bromophenyl-phenylether	10	-	10	3		0	0	No
4-Chloro-3-methylphenol	10	-	10	3		0	0	No
4-Chloroaniline	10	-	10	3		0	0	No
4-Chlorophenyl-phenyl ether	10	-	10	3		0	0	No
4-Chlorotoluene	0.500	-	1	9		0	0	No
4-Isopropyltoluene	0.500	-	1	9		0	0	No
4-Methyl-2-pentanone	10	-	10	31	170	0	0	No
4-Methylphenol	10	-	10	3	25	0	0	No
4-Nitroaniline	50	-	52	3		0	0	No
4-Nitrophenol	50	-	52	3		0	0	No
Acenaphthene	10	-	10	3	520	0	0	No
Acenaphthylene	10	-	10	3		0	0	No
Aldrin	0.0500	-	0.0520	3	0.150	0	0	No
alpha-BHC	0.0500	-	0.0520	3	2.20	0	0	No
alpha-Chlordane	0.500	-	0.520	3		0	0	No
Anthracene	10	-	10	3	0.730	3	100	No
Benzene	0.500	-	5	43	530	0	0	No
Benzo(a)anthracene	10	-	10	3	0.0270	3	100	No
Benzo(a)pyrene	10	-	10	3	0.0140	3	100	No
Benzo(b)fluoranthene	10	-	10	3		0	0	No
Benzo(g,h,i)perylene	10	-	10	3		0	0	No
Benzo(k)fluoranthene	10	-	10	3		0	0	No
Benzoic Acid	50	-	52	3	42	3	100	No
Benzyl Alcohol	10	-	10	3	8.60	3	100	No
beta-BHC	0.0500	-	0.0520	3	2.20	0	0	No
bis(2-Chloroethoxy) methane	10	-	10	3		0	0	No
bis(2-Chloroethyl) ether	10	-	10	3		0	0	No
bis(2-Chloroisopropyl) ether	10	-	10	3	29	0	0	No
bis(2-ethylhexyl)phthalate	10	-	10	3	28.5	0	0	No
Bromobenzene	0.500	-	1	9		0	0	No
Bromochloromethane	0.500	-	1	9		0	0	No
Bromodichloromethane	0.500	-	5	43	1,100	0	0	No
Bromoform	0.500	-	5	43	320	0	0	No
Bromomethane	1	-	10	43	35	0	0	No
Butylbenzylphthalate	10	-	10	3	67	0	0	No
Carbon Disulfide	1	-	5	34	0.920	34	100	No
Carbon Tetrachloride	0.500	-	5	43	3,520	0	0	No
Chlorobenzene	0.400	-	5	43	47	0	0	Yes
Chloroethane	1	-	10	43		0	0	No
Chloroform	0.200	-	5	43	1,240	0	0	Yes
Chloromethane	1	-	10	41		0	0	No
Chrysene	10	-	10	3		0	0	No
cis-1,2-Dichloroethene	0.500	-	1	9	620	0	0	No
cis-1,3-Dichloropropene	0.500	-	5	43	244	0	0	No
delta-BHC	0.0500	-	0.0520	3	2.20	0	0	No
Dibenz(a,h)anthracene	10	-	10	3		0	0	No
Dibenzofuran	10	-	10	3	4	3	100	No
Dibromochloromethane	0.500	-	5	43		0	0	No

Table A1.2.RCAEU.1
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Water in the RC AEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Dibromomethane	0.500	-	1	9		0	0	No
Dichlorodifluoromethane	1	-	1	9		0	0	No
Dieldrin	0.100	-	0.100	3	0.0560	3	100	No
Diethylphthalate	10	-	10	3	110	0	0	No
Dimethylphthalate	10	-	10	3		0	0	No
Di-n-butylphthalate	10	-	10	3	9.70	3	100	No
Di-n-octylphthalate	10	-	10	3		0	0	No
Endosulfan I	0.0500	-	0.0520	3	0.0560	0	0	No
Endosulfan II	0.100	-	0.100	3	0.0560	3	100	No
Endosulfan sulfate	0.100	-	0.100	3	0.0560	3	100	No
Endrin	0.100	-	0.100	3	0.0360	3	100	No
Endrin ketone	0.100	-	0.100	3	0.0360	3	100	No
Ethylbenzene	0.500	-	5	43	3,200	0	0	No
Fluoranthene	10	-	10	3	398	0	0	No
Fluorene	10	-	10	3	12	0	0	No
gamma-BHC (Lindane)	0.0500	-	0.0520	3	0.0800	0	0	No
gamma-Chlordane	0.500	-	0.520	3		0	0	No
Heptachlor	0.0500	-	0.0520	3	0.00380	3	100	No
Heptachlor epoxide	0.0500	-	0.0520	3	0.00380	3	100	No
Hexachlorobenzene	10	-	10	3		0	0	No
Hexachlorobutadiene	0.500	-	10	12	9.30	3	25	No
Hexachlorocyclopentadiene	10	-	10	3		0	0	No
Hexachloroethane	10	-	10	3	540	0	0	No
Indeno(1,2,3-cd)pyrene	10	-	10	3		0	0	No
Isophorone	10	-	10	3	1,300	0	0	No
Isopropylbenzene	0.500	-	1	9		0	0	No
Methoxychlor	0.500	-	0.520	3		0	0	No
Naphthalene	0.500	-	10	12	620	0	0	No
n-Butylbenzene	0.500	-	1	9		0	0	No
Nitrobenzene	10	-	10	3		0	0	No
N-Nitroso-di-n-propylamine	10	-	10	3		0	0	No
N-nitrosodiphenylamine	10	-	10	3		0	0	No
n-Propylbenzene	0.500	-	1	9		0	0	No
PCB-1016	0.500	-	0.520	3	0.0140	3	100	No
PCB-1221	0.500	-	0.520	3	0.0140	3	100	No
PCB-1232	0.500	-	0.520	3	0.0140	3	100	No
PCB-1242	0.500	-	0.520	3	0.0140	3	100	No
PCB-1248	0.500	-	0.520	3	0.0140	3	100	No
PCB-1254	1	-	1	3	0.0140	3	100	No
PCB-1260	1	-	1	3	0.0140	3	100	No
Pentachlorophenol	50	-	52	3	6.73	3	100	No
Phenanthrene	10	-	10	3	2.40	3	100	No
Phenol	10	-	10	3	2,560	0	0	No
Pyrene	10	-	10	3	0.0250	3	100	No
sec-Butylbenzene	0.500	-	1	9		0	0	No
Styrene	0.500	-	5	43	160	0	0	No
tert-Butylbenzene	0.500	-	1	9		0	0	No
Tetrachloroethene	0.500	-	10	43	840	0	0	Yes
Toluene	0.500	-	5	43	1,750	0	0	No
Toxaphene	1	-	1	3		0	0	No
trans-1,2-Dichloroethene	0.500	-	1	9	1,500	0	0	No
trans-1,3-Dichloropropene	0.500	-	5	43	244	0	0	No
Trichloroethene	0.500	-	5	43	21,900	0	0	No
Trichlorofluoromethane	0.500	-	1	9		0	0	No
Vinyl acetate	10	-	10	33		0	0	No
Vinyl Chloride	1	-	10	43	930	0	0	No

Table A1.2.RCAEU.1
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Water in the RC AEU

Analyte	Range of Nondetected Reported Results	Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Xylene	0.500 - 5	43	35	0	0	No

Table A1.2.RC AEU.2

Summary of Professional Judgment and Ecological Risk Potential for Analytes in Surface Water for the RC AEU

	SUMMARY OF PROFESSIONAL JUDGMENT												ECOLOGICAL RISK POTENTIAL								
ANALYTE	Listed as Waste Constituent for RC AEU Historical IHSSs ?[1]	Historical RFETS Inventory [2] (1974/1988) (kg)	MDC in RC AEU Surface Soil (µg/kg)	Percent Detects in RC AEU Surface Soil (µg/kg)	MDC in RC AEU Sediment (µg/kg)	Percent Detects in RC AEU Sediment (%)	MDC in RC AEU Surface Water (µg/L)	Percent Detects in RC AEU Surface Water (%)	MDC in Surface Water Sitewide (µg/L)	Detection Frequency in Sitewide Surface Water (%)	Potential to be an ECOPC?	Uncertainty Category[3]	ESL (µg/L) [4]	Acute Effects Value[5]	Maximum Reported Result for Non-Detects in RC AEU (µg/kg)	Maximum Reported Result for Non-Detects/ ESL[6]	Potential for Chronic Effects if Detected at Maximum Reported Results Level?	Maximum Reported Result for Non-Detects/ Acute Effects Value[6]	Potential for Acute Effects if Detected at Maximum Reported Results Level?
silver (dissolved)[7]	No	100/44	0.29	24	3.4	21.05	0.00024	2.7	0.9	12	Yes	3	0.00032	0.0102	0.0068	20	Yes	0.70	No
silver (total)[7]	No	100/44	0.29	24	3.4	21.05	0.00024	2.7	0.9	12	Yes	3	0.00032	0.0102	0.0068	20	Yes	0.70	No
2,4,6-trichlorophenol	No	0/.01	NA	0	NA	0.00	NA	0	NA	0	No	1	5	79	10	2	Yes	0.10	No
4,4'-DDD	No	0/.001	NA	0	NA	0.00	NA	0	0.1	0.6	No	2	0.06	0.6	0.1	2	Yes	0.20	No
4,4'-DDT	No	0/.001	NA	0	NA	0.00	NA	0	0.6	3.5	No	2	0.001	NVA	0.1	100	Yes	No AEV	I
anthracene	Yes(1)	.5/.02	NA	0	NA	0.00	NA	0	2	0.2	No	2	0.7	13	10	10	Yes	0.80	No
benzo(a)anthracene	Yes(1)	0/0	NA	0	62	5.26	NA	0	8	0.2	Yes	3	0.027	0.49	10	400	Yes	20.00	Yes
benzo(a)pyrene	Yes(1)	0/.002	NA	0	130	5.56	NA	0	9	0.2	Yes	3	0.014	0.24	10	700	Yes	40.00	Yes
benzoic acid	No	0/0	150	55	2000	35.00	NA	0	42	1.5	Yes	3	42	740	52	1	Yes	0.07	No
benzyl alcohol	No	.02/.02	NA	0	NA	0.00	NA	0	860	1.8	No	2	8.6	150	10	1	Yes	0.07	No
carbon disulfide	No	3.3/5.9	NA	0	NA	0.00	NA	0	8	0.3	No	2	0.92	17	5	5	Yes	0.30	No
dibenzofuran	No	.02/.01	NA	0	NA	0.00	NA	0	2	1	No	2	4	72	10	3	Yes	0.10	No
dieldrin	No	0/.003	NA	0	NA	0.00	NA	0	NA	0	No	2	0.056	0.24	0.1	2	Yes	0.40	No
di-n-butylphthalate	Yes(1)	0/.005	44	12	250	30.00	NA	0	48	16	Yes	3	9.7	75	10	1	Yes	0.10	No
endosulfan II	No	0/.001	NA	0	NA	0.00	NA	0	NA	0	No	1	0.056	NVA	0.1	2	Yes	No AEV	I
endosulfan sulfate	No	0/.001	NA	0	NA	0.00	NA	0	NA	0	No	1	0.056	NVA	0.1	2	Yes	No AEV	I
endrin	No	0/.004	NA	0	NA	0.00	NA	0	0.02	0.3	No	2	0.036	0.086	0.1	3	Yes	1.00	No
endrin ketone	No	0/0	NA	0	NA	0.00	NA	0	NA	0	No	1	0.036	NVA	0.1	3	Yes	No AEV	I
heptachlor	No	0/.003	NA	0	NA	0.00	NA	0	0	0.1	No	2	0.0038	0.52	0.052	10	Yes	0.10	No
heptachlor epoxide	No	0/.001	NA	0	NA	0.00	NA	0	0.05	0.3	No	2	0.0038	0.52	0.052	10	Yes	0.10	No
PCB-1016	No	0/.006	NA	0	NA	0.00	NA	0	NA	0	No	1	0.014	2	0.052	4	Yes	0.03	No
PCB-1221	No	0/.02	NA	0	NA	0.00	NA	0	NA	0	No	1	0.014	2	0.052	4	Yes	0.03	No
PCB-1232	No	0/.007	NA	0	NA	0.00	NA	0	NA	0	No	1	0.014	2	0.052	4	Yes	0.03	No
PCB-1242	No	0/.02	NA	0	NA	0.00	NA	0	NA	0	No	1	0.014	2	0.052	4	Yes	0.03	No
PCB-1248	No	0/.007	NA	0	NA	0.00	NA	0	NA	0	No	1	0.014	2	0.052	4	Yes	0.03	No
PCB-1254	No	0/.017	NA	0	NA	0.00	NA	0	24	2.3	No	2	0.014	2	1	70	Yes	0.50	No
PCB-1260	No	0/.02	NA	0	NA	0.00	NA	0	NA	0	No	1	0.014	2	1	70	Yes	0.50	No
pentachlorophenol	No	.02/.02	NA	0	1500	5.26	NA	0	5	0.4	Yes	3	6.7	17.4	52	8	Yes	3.00	Yes
phenanthrene	Yes(1)	.02/.015	NA	0	59	5.26	NA	0	11	1.9	Yes	3	2.4	43	10	4	Yes	0.20	No
pyrene	Yes(1)	.02/.02	NA	0	130	5.26	NA	0	12	1.3	No	3	0.025	NVA	10	400	Yes	No AEV	I

[1] Includes listing of the class of compound, e.g., herbicides, pesticides, chlorinated solvents, polynuclear aromatic hydrocarbons, etc. Ref. DOE, 2005b.

[2] CDH, 1991.

[3] See text for explanation.

[4] ESLs based on chronic effects value.

[5] Chronic and acute effects values are listed in Appendix B, Table B-5, "Surface Water ESLs for Aquatic Receptors", Ref. DOE 2005a.

[6] Ratios are rounded to the one significant figure.

[7] Units - mg/L for water and mg/kg for soil/sediment.

(1) Oils were spayed on PAC 000-501, Roadway Spraying. The oils are not expected to contain PCBs but may have contained polynuclear aromatic hydrocarbons and phthalates.

CDH – Colorado Department of Health
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
DOE – Department of Energy
ESL – Ecological Screening Level
IHSS – Individual Hazardous Substance Site
MDC - Maximum Detected Concentration
RC AEU – Rock Creek Aquatic Exposure Unit
RFETS – Rocky Flats Environmental Technology Site

I - Inconclusive
NA – Not applicable
ND - Not detected
NS - Not sampled
No ESL – No chronic ESL available
No AEV – No acute effects level available
NVA - No value

Table A1.2.RCAEU.3
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Sediment in the RC AEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Inorganic (mg/kg)								
Nitrite	0.300	-	0.500	2		0	0	No
Organic (ug/kg)								
1,1,2,2-Tetrachloroethane	5	-	14	10	1,900	0	0	No
1,1,2-Trichloroethane	5	-	14	11		0	0	No
1,1-Dichloroethane	5	-	14	12		0	0	No
1,1-Dichloroethene	5	-	14	12		0	0	No
1,2,4-Trichlorobenzene	330	-	2,500	19	429	16	84.2	No
1,2-Dichlorobenzene	330	-	1,600	14		0	0	No
1,2-Dichloroethane	5	-	14	12		0	0	No
1,2-Dichloroethene	5	-	14	12		0	0	No
1,2-Dichloropropane	5	-	14	11		0	0	No
1,3-Dichlorobenzene	330	-	2,500	19	122	19	100	No
1,4-Dichlorobenzene	330	-	1,600	14		0	0	No
2,4,5-Trichlorophenol	890	-	8,000	19		0	0	No
2,4,6-Trichlorophenol	330	-	2,500	19	59.3	19	100	No
2,4-Dichlorophenol	330	-	2,500	19		0	0	No
2,4-Dimethylphenol	330	-	2,500	19		0	0	No
2,4-Dinitrophenol	1,700	-	13,000	17		0	0	No
2,4-Dinitrotoluene	330	-	2,500	19		0	0	No
2,6-Dinitrotoluene	330	-	2,500	19		0	0	No
2-Chloronaphthalene	330	-	2,500	19		0	0	No
2-Chlorophenol	330	-	2,500	19		0	0	No
2-Hexanone	10	-	29	10		0	0	No
2-Methylnaphthalene	330	-	2,500	19	20.2	19	100	No
2-Methylphenol	330	-	2,500	19	6,970	0	0	No
2-Nitroaniline	1,700	-	13,000	19		0	0	No
2-Nitrophenol	330	-	2,500	19		0	0	No
3,3'-Dichlorobenzidine	660	-	5,000	16		0	0	No
3-Nitroaniline	1,700	-	13,000	17		0	0	No
4,4'-DDD	20	-	82	13	4.88	13	100	No
4,4'-DDE	20	-	82	13	3.16	13	100	No
4,4'-DDT	20	-	82	13	4.16	13	100	No
4-Bromophenyl-phenylether	330	-	2,500	19	166	19	100	No
4-Chloro-3-methylphenol	330	-	5,000	19		0	0	No
4-Chloroaniline	330	-	5,000	18		0	0	No
4-Chlorophenyl-phenyl ether	330	-	2,500	19		0	0	No
4-Methyl-2-pentanone	10	-	29	10		0	0	No
4-Nitroaniline	1,700	-	13,000	17		0	0	No
Acenaphthene	330	-	1,600	19	6.71	19	100	No
Acenaphthylene	330	-	1,600	19	5.87	19	100	No
Aldrin	10	-	41	13	8.25	13	100	No
alpha-BHC	10	-	41	13	43.9	0	0	No
alpha-Chlordane	100	-	410	13	3.24	13	100	No
Anthracene	330	-	1,600	19	57.2	19	100	No
Benzene	5	-	14	11	260	0	0	No
Benzo(b)fluoranthene	330	-	2,500	18		0	0	No
Benzo(g,h,i)perylene	330	-	2,500	16	13	16	100	No
Benzo(k)fluoranthene	330	-	2,500	18	240	18	100	No
Benzyl Alcohol	330	-	5,000	19	1.35	19	100	No
beta-BHC	10	-	41	13	93.6	0	0	No
beta-Chlordane	100	-	400	3	3.24	3	100	No
bis(2-Chloroethoxy) methane	330	-	2,500	19		0	0	No
bis(2-Chloroethyl) ether	330	-	2,500	19		0	0	No
bis(2-Chloroisopropyl) ether	330	-	2,500	19		0	0	No
Bromodichloromethane	5	-	14	11		0	0	No

Table A1.2.RCAEU.3
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Sediment in the RC AEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Bromoform	5	-	14	11		0	0	No
Bromomethane	10	-	29	11	3.43	11	100	No
Butylbenzylphthalate	330	-	2,500	18	11,400	0	0	No
Carbon Disulfide	5	-	14	12		0	0	No
Carbon Tetrachloride	5	-	14	11	7,890	0	0	No
Chlorobenzene	5	-	14	10		0	0	No
Chloroethane	10	-	29	11		0	0	No
Chloroform	5	-	14	12		0	0	No
Chloromethane	10	-	29	12		0	0	No
cis-1,3-Dichloropropene	5	-	14	11		0	0	No
delta-BHC	10	-	41	13	2.37	13	100	No
Dibenz(a,h)anthracene	330	-	2,500	18	33	18	100	No
Dibenzofuran	330	-	2,500	19	325	19	100	No
Dibromochloromethane	5	-	14	11		0	0	No
Dieldrin	20	-	82	13	5.94	13	100	No
Diethylphthalate	330	-	2,500	19	108	19	100	No
Dimethylphthalate	330	-	2,500	19		0	0	No
Di-n-octylphthalate	330	-	2,500	18		0	0	No
Endosulfan I	10	-	41	13	0.690	13	100	No
Endosulfan II	20	-	82	13	0.690	13	100	No
Endosulfan sulfate	20	-	82	13	0.690	13	100	No
Endrin	20	-	82	13		0	0	No
Endrin ketone	20	-	82	13		0	0	No
Ethylbenzene	5	-	14	10	16,570	0	0	No
Fluorene	330	-	2,500	19	77.4	19	100	No
gamma-BHC (Lindane)	10	-	41	13	2.37	13	100	No
gamma-Chlordane	130	-	410	10	3.24	10	100	No
Heptachlor	10	-	41	13	0.132	13	100	No
Heptachlor epoxide	10	-	41	13	2.47	13	100	No
Hexachlorobenzene	330	-	2,500	19		0	0	No
Hexachlorobutadiene	330	-	2,500	19	23	19	100	No
Hexachlorocyclopentadiene	330	-	2,500	17		0	0	No
Hexachloroethane	330	-	2,500	19		0	0	No
Indeno(1,2,3-cd)pyrene	330	-	2,500	16	17	16	100	No
Isophorone	330	-	2,500	19		0	0	No
Methoxychlor	100	-	410	13	24	13	100	No
Naphthalene	330	-	2,500	19	176	19	100	No
Nitrobenzene	330	-	2,500	19		0	0	No
N-Nitroso-di-n-propylamine	330	-	2,500	19		0	0	No
N-nitrosodiphenylamine	330	-	2,500	19		0	0	No
PCB-1016	100	-	410	13	40	13	100	No
PCB-1221	100	-	410	13	40	13	100	No
PCB-1232	100	-	410	13	40	13	100	No
PCB-1242	100	-	410	13	40	13	100	No
PCB-1248	100	-	410	13	40	13	100	No
PCB-1254	200	-	820	13	40	13	100	No
PCB-1260	200	-	820	13	40	13	100	No
Pyridine	890	-	2,500	5		0	0	No
Styrene	5	-	14	10		0	0	No
Toxaphene	200	-	820	13		0	0	No
trans-1,3-Dichloropropene	5	-	14	11		0	0	No
Vinyl acetate	10	-	29	11		0	0	No
Vinyl Chloride	10	-	29	12		0	0	No

Table A1.2RCAEU.4
Summary of Professional Judgment and Ecological Risk Potential for Analytes in Sediment for the RC AEU

ANALYTE	SUMMARY OF PROFESSIONAL JUDGMENT										ECOLOGICAL RISK POTENTIAL				
	Listed as Waste Constituent for RC AEU Historical IHSSs ?[1]	Historical RFETS Inventory [2] (1974/1988) (kg)	MDC in RC AEU Surface Soil (ug/kg)	Percent Detects in RC AEU Surface Soil (%)	MDC in RC AEU Sediment (ug/kg)	Percent Detects in RC AEU Sediment (%)	MDC in Sediment Sitewide (ug/kg)	Percent Detects in Sitewide Sediment (%)	Potential to be an ECOPC?	Uncertainty Category[3]	ESL[4] (ug/kg)	LOEC [5]	Maximum Reported Result for Non-detects in RC AEU (ug/kg)	Maximum Reported Result/ LOEC[6]	Potential for Adverse Effects if Detected at Reported Results Level?
1,2,4-trichlorobenzene	No	.02/.015	NA	0	NA	0	2	0.3	No	2	429	NVA	2.500	NA	I
1,3-dichlorobenzene	No	0/.01	NA	0	NA	0	NA	0	No	1	121.52	NVA	2,500	NA	I
2,4,6-trichlorophenol	No	0/.01	NA	0	NA	0	NA	0	No	1	59.3	NVA	2,500	NA	I
2-methylnaphthalene	Yes(1)	0/.110	NA	0	NA	0	2000	3.1	Yes	3	20.2	201	2,500	10	Yes
4,4'DDD	No	0/.001	NA	0	NA	0	4.1	0.4	No	2	4.88	NVA	82	NA	I
4,4'DDE	No	0/.001	NA	0	NA	0	18	2.2	No	2	3.16	NVA	82	NA	I
4,4'DDT	No	0/.001	NA	0	NA	0	18	2.2	No	2	4.16	62.9	82	1	No
4-bromophenyl-phenylether	No	0/.005	NA	0	NA	0	NA	0	No	1	166	NVA	2,500	NA	I
acenaphthene	Yes(1)	.02/.02	NA	0	NA	0	620	14	Yes	3	6.71	89	1,600	20	Yes
acenaphthylene	Yes(1)	.02/.02	NA	0	NA	0	NA	0	No	2	5.87	NVA	1,600	NA	I
aldrin	No	0/.003	NA	0	NA	0	54	1.3	No	2	8.25	NVA	41	NA	I
alpha-chlordane	No	0/0	NA	0	NA	0	NA	0	No	1	3.24	NVA	410	NA	I
anthracene	Yes(1)	0/2.84	NA	0	NA	0	970	26	Yes	3	57.2	845	1,600	2	Yes
benzo(g,h,i)perylene	Yes(1)	0/0	NA	0	NA	0	1100	25	Yes	3	13	280	2,500	9	Yes
benzo(k)fluoranthene	Yes(1)	0/0	NA	0	NA	0	1200	29	No	2	240	750	2,500	3	Yes
benzyl alcohol	No	.02/.02	NA	0	NA	0	41	0.4	No	2	1.35	NVA	5,000	NA	I
beta-chlordane	No	0/0	NA	0	NA	0	NA	0	No	1	3.24	NVA	400	NA	I
bromomethane	No	NVA	NA	0	NA	0	5	2.4	No	2	3.43	NVA	29	NA	I

Table A1.2RCAEU.4
Summary of Professional Judgment and Ecological Risk Potential for Analytes in Sediment for the RC AEU

ANALYTE	SUMMARY OF PROFESSIONAL JUDGMENT										ECOLOGICAL RISK POTENTIAL				
	Listed as Waste Constituent for RC AEU Historical IHSSs ?[1]	Historical RFETS Inventory [2] (1974/1988) (kg)	MDC in RC AEU Surface Soil (ug/kg)	Percent Detects in RC AEU Surface Soil (%)	MDC in RC AEU Sediment (ug/kg)	Percent Detects in RC AEU Sediment (%)	MDC in Sediment Sitewide (ug/kg)	Percent Detects in Sitewide Sediment (%)	Potential to be an ECOPC?	Uncertainty Category[3]	ESL[4] (ug/kg)	LOEC [5]	Maximum Reported Result for Non-detects in RC AEU (ug/kg)	Maximum Reported Result/ LOEC[6]	Potential for Adverse Effects if Detected at Reported Results Level?
delta-BHC	No	0/0	NA	0	NA	0	13	1.3	No	2	2.37	NVA	41	NA	I
dbenz(a,h)anthracene	Yes(1)	0/.005	NA	0	NA	0	530	7.6	Yes	3	33	240	2,500	10	Yes
dibenzofuran	No	.02/.01	NA	0	NA	0	300	3.8	No	2	325	NVA	2,500	NA	I
dieldrin	No	0/.003	NA	0	NA	0	4.6	0.4	No	2	5.94	NVA	82	NA	I
diethylphthalate	Yes(1)	0/.03	NA	0	NA	0	79	1.0	No	2	108	NVA	2,500	NA	I
endosulfan I	No	0/.001	NA	0	NA	0	20	1.3	No	2	0.69	NVA	41	NA	I
endosulfan II	No	0/.001	NA	0	NA	0	NA	0	No	1	0.69	NVA	82	NA	I
endosulfan sulfate	No	0/.002	NA	0	NA	0	NA	0	No	1	0.69	NVA	82	NA	I
fluorene	Yes(1)	.02/.015	NA	0	NA	0	650	9.6	No	2	77.4	536	2,500	5	Yes
gamma-BHC (lindane)	No	0/.002	NA	0	NA	0	25	0.9	No	2	2.37	NVA	41	NA	I
gamma-chlordane	No	0/.003	NA	0	NA	0	NA	0	No	1	3.24	NVA	410	NA	I
heptachlor	No	0/.003	NA	0	NA	0	3.1	1.3	No	2	0.132	16	41	3	Yes
heptachlor epoxide	No	0/.001	NA	0	NA	0	33	1.3	No	2	2.47	16	41	3	Yes
hexachlorobutadiene	No	0/.005	NA	0	NA	0	2	0.3	No	2	23	NVA	2,500	NA	I
indeno(1,2,3-cd)pyrene	Yes (1)	0/.005	NA	0	NA	0	910	28	Yes	3	17	250	2,500	10	Yes
methoxychlor	No	0/.002	NA	0	NA	0	2.7	0.4	No	2	24	NVA	410	NA	I
naphthalene	No	1.8/.922	NA	0	NA	0	320	6.4	No	2	176	561	2,500	5	Yes
PCB-1016	No	0/.006	NA	0	NA	0	NA	0	No	1	40	NVA	410	NA	I

Table A1.2RCAEU.4
Summary of Professional Judgment and Ecological Risk Potential for Analytes in Sediment for the RC AEU

Analyte	Summary of Professional Judgment										Ecological Risk Potential				
	Listed as Waste Constituent for RC AEU Historical IHSSs ?[1]	Historical RFETS Inventory [2] (1974/1988) (kg)	MDC in RC AEU Surface Soil (ug/kg)	Percent Detects in RC AEU Surface Soil (%)	MDC in RC AEU Sediment (ug/kg)	Percent Detects in RC AEU Sediment (%)	MDC in Sediment Sitewide (ug/kg)	Percent Detects in Sitewide Sediment (%)	Potential to be an ECOPC?	Uncertainty Category[3]	ESL[4] (ug/kg)	LOEC [5]	Maximum Reported Result for Non-detects in RC AEU (ug/kg)	Maximum Reported Result/ LOEC[6]	Potential for Adverse Effects if Detected at Reported Results Level?
PCB-1221	No	0/.02	NA	0	NA	0	NA	0	No	1	40	NVA	410	NA	I
PCB-1232	No	0/.007	NA	0	NA	0	NA	0	No	1	40	NVA	410	NA	I
PCB-1242	No	0/.02	NA	0	NA	0	NA	0	No	1	40	NVA	410	NA	I
PCB-1248	No	0/.007	NA	0	NA	0	NA	0	No	1	40	NVA	410	NA	I
PCB-1254	No	0/.017	NA	0	NA	0	5200	23	No	2	40	300	820	3	Yes
PCB-1260	No	0/.018	NA	0	NA	0	2000	2.3	No	2	40	NVA	820	NA	I

[1] Includes listing of the class of compound, e.g., herbicides, pesticides, chlorinated solvents, polynuclear aromatic hydrocarbons, etc. Ref. DOE, 2005b.
[2] CDH, 1991.
[3] See text for explanation.
[4] Basis for the NOEC.
[5] LOECs developed as described in Attachment 5 to Appendix A, Volumes 15B1 and 15B2 of the RI/FS report.
[6] Ratio is rounded to one significant figure.

(1) Oils were spayed on PAC 000-501, Roadway Spraying. The oils are not expected to contain PCBs but may have contained polynuclear aromatic hydrocarbons and phthalates.

CDH – Colorado Department of Health
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
DOE – Department of Energy
ESL – Ecological Screening Level
IHSS – Individual Hazardous Substance Site
LOEC –Lowest Observed Effect Concentration
MDC – Maximum Detected Concentration
NOEC - No Observed Effect Concentration
RC AEU – Rock Creek Aquatic Exposure Unit
PCB – Polychlorinated Biphenyl
RFETS – Rocky Flats Environmental Technology Site

I - Inconclusive
NA – Not applicable
NVA – No value available

Table A1.2.MKAEU.1
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Water in the MK AEU

Analyte	Range of Nondetected Reported Results			Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Inorganic (Dissolved) (mg/L)								
Ammonia		-		0	0.0200	0	0	No
Antimony	3.40E-04	-	0.0422	26	0.240	0	0	Yes
Beryllium	1.00E-04	-	0.00100	26	0.00240	0	0	Yes
Cadmium	2.00E-04	-	0.00460	26	2.50E-04	18	69.2	Yes
Cyanide		-		0	5.00E-04	0	0	No
Mercury	2.00E-04	-	2.00E-04	22	7.70E-04	0	0	Yes
Molybdenum	2.20E-04	-	0.0140	26	0.800	0	0	Yes
Silver	1.00E-04	-	0.00680	26	3.20E-04	15	57.7	Yes
Sulfide		-		0		0	0	No
Thallium	1.00E-04	-	0.109	26	0.0150	3	11.5	Yes
Tin	0.00100	-	0.0389	26	0.0730	0	0	Yes
Inorganic (Total) (mg/L)								
Ammonia	0.100	-	0.200	5	0.0200	5	100	No
Antimony	4.40E-04	-	0.0500	39	0.240	0	0	Yes
Beryllium	1.00E-04	-	0.00500	39	0.00240	7	17.9	Yes
Cadmium	1.00E-04	-	0.00500	39	2.50E-04	36	92.3	Yes
Cyanide	0	-	0.0200	12	5.00E-04	11	91.7	No
Mercury	4.40E-05	-	2.00E-04	33	7.70E-04	0	0	Yes
Molybdenum	2.60E-04	-	0.0150	34	0.800	0	0	Yes
Silver	1.00E-04	-	0.00680	39	3.20E-04	30	76.9	Yes
Sulfide	1	-	1	12		0	0	No
Thallium	1.00E-04	-	0.109	39	0.0150	5	12.8	Yes
Tin	0.00100	-	0.0500	34	0.0730	0	0	Yes
Organic (ug/L)		-						
1,1,1-Trichloroethane	5	-	10	13	89	0	0	No
1,1,2,2-Tetrachloroethane	5	-	10	13	2,400	0	0	No
1,1,2-Trichloroethane	5	-	10	13	940	0	0	No
1,1-Dichloroethane	5	-	10	13	740	0	0	No
1,1-Dichloroethene	5	-	10	13	65	0	0	No
1,2,4-Trichlorobenzene	10	-	11	2	50	0	0	No
1,2-Dichlorobenzene	10	-	11	2	13	0	0	No
1,2-Dichloroethane	5	-	10	13	20,000	0	0	No
1,2-Dichloroethene	5	-	10	13	1,100	0	0	No
1,2-Dichloropropane	5	-	10	13	5,700	0	0	No
1,3-Dichlorobenzene	10	-	11	2	28	0	0	No
1,4-Dichlorobenzene	10	-	11	2	16	0	0	No
2,4,5-Trichlorophenol	28	-	28	1		0	0	No
2,4,6-Trichlorophenol	11	-	11	1	5	1	100	No
2,4-Dichlorophenol	11	-	11	1	365	0	0	No
2,4-Dimethylphenol	11	-	11	1	212	0	0	No
2,4-Dinitrophenol	28	-	28	1		0	0	No
2,4-Dinitrotoluene	10	-	11	2		0	0	No
2,6-Dinitrotoluene	10	-	11	2		0	0	No
2-Chloronaphthalene	10	-	11	2	630	0	0	No
2-Chlorophenol	11	-	11	1		0	0	No
2-Hexanone	10	-	10	13	99	0	0	No
2-Methylnaphthalene	10	-	11	2		0	0	No
2-Methylphenol	11	-	11	1	82	0	0	No
2-Nitroaniline	28	-	50	2		0	0	No
2-Nitrophenol	11	-	11	1		0	0	No
3,3'-Dichlorobenzidine	11	-	20	2		0	0	No
3-Nitroaniline	28	-	50	2		0	0	No
4,4'-DDD	0.100	-	0.120	3	0.0600	3	100	No
4,4'-DDE	0.100	-	0.120	3	105	0	0	No
4,4'-DDT	0.100	-	0.120	3	0.00100	3	100	No
4,6-Dinitro-2-methylphenol	28	-	28	1		0	0	No
4-Bromophenyl-phenylether	10	-	11	2		0	0	No

Table A1.2.MKAEU.1
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Water in the MK AEU

Analyte	Range of Nondetected Reported Results			Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
4-Chloro-3-methylphenol	11	-	11	1		0	0	No
4-Chloroaniline	10	-	11	2		0	0	No
4-Chlorophenyl-phenyl ether	10	-	11	2		0	0	No
4-Methyl-2-pentanone	10	-	10	13	170	0	0	No
4-Methylphenol	11	-	11	1	25	0	0	No
4-Nitroaniline	28	-	50	2		0	0	No
4-Nitrophenol	28	-	28	1		0	0	No
Acenaphthene	10	-	11	2	520	0	0	No
Acenaphthylene	10	-	11	2		0	0	No
Acetone	10	-	26	13	1,500	0	0	No
Aldrin	0.0500	-	0.0580	3	0.150	0	0	No
alpha-BHC	0.0500	-	0.0580	3	2.20	0	0	No
alpha-Chlordane	0.0500	-	0.500	3		0	0	No
Anthracene	10	-	11	2	0.730	2	100	No
Benzene	5	-	10	13	530	0	0	No
Benzo(a)anthracene	10	-	11	2	0.0270	2	100	No
Benzo(a)pyrene	10	-	11	2	0.0140	2	100	No
Benzo(b)fluoranthene	10	-	11	2		0	0	No
Benzo(g,h,i)perylene	10	-	11	2		0	0	No
Benzo(k)fluoranthene	10	-	11	2		0	0	No
beta-BHC	0.0500	-	0.0580	3	2.20	0	0	No
beta-Chlordane	0.0500	-	0.500	3		0	0	No
bis(2-Chloroethoxy) methane	10	-	11	2		0	0	No
bis(2-Chloroethyl) ether	10	-	11	2		0	0	No
bis(2-Chloroisopropyl) ether	10	-	11	2	29	0	0	No
Bromodichloromethane	5	-	10	13	1,100	0	0	No
Bromoform	5	-	10	13	320	0	0	No
Bromomethane	10	-	10	13	35	0	0	No
Butylbenzylphthalate	10	-	11	2	67	0	0	No
Carbazole	11	-	11	1	4	1	100	No
Carbon Disulfide	5	-	10	13	0.920	13	100	No
Carbon Tetrachloride	5	-	10	13	3,520	0	0	No
Chlorobenzene	5	-	10	13	47	0	0	No
Chloroethane	10	-	10	13		0	0	No
Chloroform	5	-	10	13	1,240	0	0	No
Chloromethane	10	-	10	12		0	0	No
Chrysene	10	-	11	2		0	0	No
cis-1,3-Dichloropropene	5	-	10	13	244	0	0	No
delta-BHC	0.0500	-	0.0580	3	2.20	0	0	No
Dibenz(a,h)anthracene	10	-	11	2		0	0	No
Dibenzofuran	10	-	11	2	4	2	100	No
Dibromochloromethane	5	-	10	13		0	0	No
Dieldrin	0.100	-	0.120	3	0.0560	3	100	No
Diethylphthalate	10	-	11	2	110	0	0	No
Dimethylphthalate	10	-	11	2		0	0	No
Di-n-butylphthalate	10	-	11	2	9.70	2	100	No
Di-n-octylphthalate	10	-	11	2		0	0	No
Endosulfan I	0.0500	-	0.0580	3	0.0560	1	33.3	No
Endosulfan II	0.100	-	0.120	3	0.0560	3	100	No
Endosulfan sulfate	0.100	-	0.120	3	0.0560	3	100	No
Endrin	0.100	-	0.120	3	0.0360	3	100	No
Endrin aldehyde	0.100	-	0.120	2	0.0360	2	100	No
Endrin ketone	0.100	-	0.120	3	0.0360	3	100	No
Ethylbenzene	5	-	10	13	3,200	0	0	No
Fluoranthene	10	-	11	2	398	0	0	No
Fluorene	10	-	11	2	12	0	0	No
gamma-BHC (Lindane)	0.0500	-	0.0580	3	0.0800	0	0	No
Heptachlor	0.0500	-	0.0580	3	0.00380	3	100	No

Table A1.2.MKAEU.1
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Water in the MK AEU

Analyte	Range of Nondetected Reported Results			Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Heptachlor epoxide	0.0500	-	0.0580	3	0.00380	3	100	No
Hexachlorobenzene	10	-	11	2		0	0	No
Hexachlorobutadiene	10	-	11	2	9.30	2	100	No
Hexachlorocyclopentadiene	10	-	11	2		0	0	No
Hexachloroethane	10	-	11	2	540	0	0	No
Indeno(1,2,3-cd)pyrene	10	-	11	2		0	0	No
Isophorone	10	-	11	2	1,300	0	0	No
Methoxychlor	0.500	-	0.580	3		0	0	No
Naphthalene	10	-	11	2	620	0	0	No
Nitrobenzene	10	-	11	2		0	0	No
N-Nitroso-di-n-propylamine	10	-	11	2		0	0	No
N-nitrosodiphenylamine	10	-	11	2		0	0	No
PCB-1016	0.500	-	1.20	3	0.0140	3	100	No
PCB-1221	0.500	-	2.30	3	0.0140	3	100	No
PCB-1232	0.500	-	1.20	3	0.0140	3	100	No
PCB-1242	0.500	-	1.20	3	0.0140	3	100	No
PCB-1248	0.500	-	1.20	3	0.0140	3	100	No
PCB-1254	1	-	1.20	3	0.0140	3	100	No
PCB-1260	1	-	1.20	3	0.0140	3	100	No
Pentachlorophenol	28	-	28	1	6.73	1	100	No
Phenanthrene	10	-	11	2	2.40	2	100	No
Phenol	11	-	11	1	2,560	0	0	No
Pyrene	10	-	11	2	0.0250	2	100	No
Styrene	5	-	10	13	160	0	0	No
Toluene	5	-	10	13	1,750	0	0	No
Toxaphene	1	-	5.80	3		0	0	No
trans-1,3-Dichloropropene	5	-	10	13	244	0	0	No
Vinyl acetate	10	-	10	12		0	0	No
Vinyl Chloride	10	-	10	13	930	0	0	No
Xylene	5	-	10	13	35	0	0	No

Table A1.2.MK AEU.2
Summary of Professional Judgment and Ecological Risk Potential for Analytes in Surface Water for the MK AEU

	SUMMARY OF PROFESSIONAL JUDGMENT												ECOLOGICAL RISK POTENTIAL						
ANALYTE	Listed as Waste Constituent for MK AEU Historical IHSSs ?1	Historical RFETS Inventory [2] (1974/1988) (kg)	MDC in MK AEU Surface Soil (µg/kg)	Percent Detects in MK AEU Surface Soil (µg/kg)	MDC in MK AEU Sediment (µg/kg)	Percent Detects in MK AEU Sediment (%)	MDC in MK AEU Surface Water (µg/L)	Percent Detects in MK AEU Surface Water (%)	MDC in Surface Water Sitewide (µg/L)	Detection Frequency in Sitewide Surface Water (%)	Potential to be an ECOPC?	Uncertainty Category[3]	ESL (µg/L) [4]	Acute Effects Value[5]	Maximum Reported Result for Non-Detects in MK AEU (µg/kg)	Maximum Reported Result for Non-Detects/ ESL[6]	Potential for Chronic Effects if Detected at Maximum Reported Results Level?	Maximum Reported Result for Non-Detects/ Acute Effects Value[6]	Potential for Acute Effects if Detected at Maximum Reported Results Level?
cadmium (dissolved)7	Yes(2)	100/44	1.4	53	0.49	41.67	0.0045	2.6	0.0483	35	Yes	4	0.00025	0.005	0.0046	20	Yes	0.90	No
cadmium (total)7	Yes(2)	100/44	1.4	53	0.49	41.67	0.0045	2.6	0.0483	35	Yes	4	0.00025	0.005	0.005	20	Yes	1	No
cyanide(total)7	No	.06/.43	NA	0	NS	0.00	NA	0	0.026	4.8	No	2	0.0005	0.005	0.02	40	Yes	4	Yes
silver (dissolved)7	Yes(2)	27/19	0.6	8.6	NA	0.00	0.0028	5.1	0.913	12	Yes	4	0.00032	0.0102	0.0068	20	Yes	0.70	No
silver (total)7	Yes(2)	27/19	0.6	8.6	NA	0.00	0.0028	5.1	0.913	12	Yes	4	0.00032	0.0102	0.0068	20	Yes	0.70	No
2,4,6-trichlorophenol	No	0/.01	NA	0	NA	0.00	NA	0	NA	0	No	1	5	79	11	2	Yes	0.10	No
4,4'-DDD	No	0/.001	NA	0	NA	0.00	NA	0	0.1	0.6	No	2	0.06	0.6	0.12	2	Yes	0.20	No
4,4'-DDT	No	0/.001	NA	0	NA	0.00	NA	0	0.6	3.5	No	2	0.001	NVA	0.12	100	Yes	No AEV	I
anthracene	Yes(1)	.5/.02	NA	0	NA	0.00	NA	0	2	0.2	No	2	0.7	13	11	20	Yes	0.90	No
benzo(a)anthracene	Yes(1)	0/0	NA	0	NA	0.00	NA	0	8	0.2	Yes	3	0.027	0.49	11	400	Yes	20	Yes
benzo(a)pyrene	Yes(1)	0/.002	NA	0	NA	0.00	NA	0	9	0.2	Yes	3	0.014	0.24	11	800	Yes	50	Yes
carbazole	No	0/.01	NA	0	NA	0.00	NA	0	3	1.9	No	2	4	72	11	3	Yes	0.20	No
carbon disulfide	No	3.3/5.9	NA	0	NA	0.00	NA	0	8	0.3	No	2	0.92	17	10	10	Yes	0.60	No
dibenzofuran	No	.02/.01	NA	0	NA	0.00	NA	0	2	1	No	2	4	72	11	3	Yes	0.20	No
dieldrin	No	0/.003	NA	0	NA	0.00	NA	0	NA	0	No	1	0.056	0.24	0.12	2	Yes	0.20	No
di-n-butylphthalate	Yes(1)	0/.005	NA	0	280	37.50	NA	0	48	16	Yes	3	9.7	75	11	1	Yes	0.20	No
endosulfan II	No	0/.001	NA	0	NA	0.00	NA	0	NA	0	No	1	0.056	NVA	0.12	2	Yes	No AEV	I
endosulfan sulfate	No	0/.001	NA	0	NA	0.00	NA	0	NA	0	No	1	0.056	NVA	0.12	2	Yes	No AEV	I
endrin	No	0/.004	NA	0	NA	0.00	NA	0	0.02	0.3	No	2	0.036	0.086	0.12	3	Yes	1.00	No
endrin aldehyde	No	0/.002	NA	0	NA	0.00	NA	0	NA	0	No	1	0.036	NVA	0.12	3	Yes	No AEV	I
endrin ketone	No	0/0	NA	0	NA	0.00	NA	0	NA	0	No	1	0.036	NVA	0.12	3	Yes	No AEV	I
heptachlor	No	0/.003	NA	0	NA	0.00	NA	0	0	0.96	No	2	0.0038	0.52	0.058	20	Yes	0.10	No
heptachlor epoxide	No	0/.001	NA	0	NA	0.00	NA	0	0.05	0.3	No	2	0.0038	0.52	0.058	20	Yes	0.10	No
hexachlorobutadiene	No	0/.005	NA	0	NA	0.00	NA	0	0.29	0.11	No	2	9.3	90	11	1	Yes	0.10	No
PCB-1016	No	0/.006	NA	0	NA	0.00	NA	0	NA	0	No	1	0.014	2	1.2	90	Yes	0.60	No
PCB-1221	No	0/.02	NA	0	NA	0.00	NA	0	NA	0	No	1	0.014	2	2.3	200	Yes	1	No
PCB-1232	No	0/.007	NA	0	NA	0.00	NA	0	NA	0	No	1	0.014	2	1.2	90	Yes	0.60	No
PCB-1242	No	0/.02	NA	0	NA	0.00	NA	0	NA	0	No	1	0.014	2	1.2	90	Yes	0.60	No
PCB-1248	No	0/.007	NA	0	NA	0.00	NA	0	NA	0	No	1	0.014	2	1.2	90	Yes	0.60	No
PCB-1254	No	0/.017	NA	0	NA	0.00	NA	0	24	2.3	No	2	0.014	2	1.2	90	Yes	0.60	No
PCB-1260	No	0/.02	NA	0	NA	0.00	NA	0	NA	0	No	1	0.014	2	1.2	90	Yes	0.60	No
pentachlorophenol	No	.02/.02	NA	0	NA	0.00	NA	0	5	0.4	No	2	6.7	17.4	28	4	Yes	2	Yes
phenanthrene	Yes(1)	.02/.15	NA	0	96	12.50	NA	0	11	1.9	Yes	3	2.4	43	11	5	Yes	0.30	No
pyrene	Yes(1)	.02/.02	NA	0	170	25.00	NA	0	12	1.3	Yes	3	0.025	NVA	11	400	Yes	No AEV	I

[1] Includes listing of the class of compound, e.g., herbicides, pesticides, chlorinated solvents, polynuclear aromatic hydrocarbons, etc. Ref. DOE, 2005b.

[2] CDH, 1991.

[3] See text for explanation.

[4] ESLs based on chronic effects value.

[5] Chronic and acute effects values are listed in Appendix B, Table B-5, "Surface Water ESLs for Aquatic Receptors", Ref. DOE 2005a.

[6] Ratios are rounded to the one significant figure.

[7] Units - mg/L for water and mg/kg for soil/sediment.

(1) Oils were spayed on PAC 000-501, Roadway Spraying. The oils are not expected to contain PCBs but may have contained polynuclear aromatic hydrocarbons and phthalates.

(2) Excess water from the Solar Evaporation Ponds (IHSS 101) was sprayed at the West Spray Field (PAC 000-168) located in the MK AEU. The ponds were used primarily for the evaporation of low-level radioactive wastes contaminated with high concentrations of nitrate, but also contained metals.

Shaded entries are analytes that have both a potential to be an ECOPC and a potential for acute effects if detected at the maximum reported results level.

CDH – Colorado Department of Health

DDE – dichlorodiphenyldichloroethylene

DDT – dichlorodiphenyltrichloroethane

DOE – Department of Energy

ESL – Ecological Screening Level

IHSS – Individual Hazardous Substance Site

MDC - Maximum Detected Concentration

MK AEU – McKay Ditch Aquatic Exposure Unit

RFETS – Rocky Flats Environmental Technology Site

I - Inconclusive
NA – Not applicable
ND - Not detected
NS - Not sampled
No ESL – No chronic ESL available
No AEV – No acute effects level available
NVA - No value

Table A1.2.MKAEU.3
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Sediment in the MK AEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Max Result > ESL?	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Inorganic (mg/kg)									
Nitrite	0.400	-	0.400	1		N/A	0	0	No
Silver	0.0780	-	1.94	12	1	Yes	3	25	No
Organic (ug/kg)									
1,1,1-Trichloroethane	5	-	27	8	159	No	0	0	No
1,1,2,2-Tetrachloroethane	5	-	27	8	1,900	No	0	0	No
1,1,2-Trichloroethane	5	-	27	8		N/A	0	0	No
1,1-Dichloroethane	5	-	27	8		N/A	0	0	No
1,1-Dichloroethene	5	-	27	8		N/A	0	0	No
1,2,4-Trichlorobenzene	340	-	1,200	8	429	Yes	6	75	No
1,2-Dichlorobenzene	340	-	1,200	8		N/A	0	0	No
1,2-Dichloroethane	5	-	27	8		N/A	0	0	No
1,2-Dichloroethene	5	-	27	8		N/A	0	0	No
1,2-Dichloropropane	5	-	27	8		N/A	0	0	No
1,3-Dichlorobenzene	340	-	1,200	8	122	Yes	8	100	No
1,4-Dichlorobenzene	340	-	1,200	8		N/A	0	0	No
2,4,5-Trichlorophenol	1,700	-	5,600	8		N/A	0	0	No
2,4,6-Trichlorophenol	340	-	1,200	8	59.3	Yes	8	100	No
2,4-Dichlorophenol	340	-	1,200	8		N/A	0	0	No
2,4-Dimethylphenol	340	-	1,200	8		N/A	0	0	No
2,4-Dinitrophenol	1,700	-	5,600	8		N/A	0	0	No
2,4-Dinitrotoluene	340	-	1,200	8		N/A	0	0	No
2,6-Dinitrotoluene	340	-	1,200	8		N/A	0	0	No
2-Chloronaphthalene	340	-	1,200	8		N/A	0	0	No
2-Chlorophenol	340	-	1,200	8		N/A	0	0	No
2-Hexanone	10	-	27	7		N/A	0	0	No
2-Methylnaphthalene	340	-	1,200	8	20.2	Yes	8	100	No
2-Methylphenol	340	-	1,200	8	6,970	No	0	0	No
2-Nitroaniline	1,700	-	5,600	8		N/A	0	0	No
2-Nitrophenol	340	-	1,200	8		N/A	0	0	No
3,3'-Dichlorobenzidine	680	-	1,800	7		N/A	0	0	No
3-Nitroaniline	1,700	-	5,600	7		N/A	0	0	No
4,4'-DDD	9	-	56	8	4.88	Yes	8	100	No
4,4'-DDE	9	-	56	8	3.16	Yes	8	100	No
4,4'-DDT	9	-	56	8	4.16	Yes	8	100	No
4,6-Dinitro-2-methylphenol	1,700	-	5,600	8		N/A	0	0	No
4-Bromophenyl-phenylether	340	-	1,200	8	166	Yes	8	100	No
4-Chloro-3-methylphenol	340	-	1,200	8		N/A	0	0	No
4-Chloroaniline	340	-	1,200	8		N/A	0	0	No
4-Chlorophenyl-phenyl ether	340	-	1,200	8		N/A	0	0	No
4-Methyl-2-pentanone	10	-	27	8		N/A	0	0	No
4-Nitroaniline	1,700	-	4,300	7		N/A	0	0	No
4-Nitrophenol	1,700	-	5,600	8		N/A	0	0	No
Acenaphthene	340	-	1,200	8	6.71	Yes	8	100	No
Acenaphthylene	340	-	1,200	8	5.87	Yes	8	100	No
Acetone	13	-	210	8		N/A	0	0	No
Aldrin	4.50	-	28	8	8.25	Yes	6	75	No
alpha-BHC	4.50	-	28	8	43.9	No	0	0	No
alpha-Chlordane	4.50	-	280	8	3.24	Yes	8	100	No
Anthracene	340	-	1,200	8	57.2	Yes	8	100	No
Benzene	5	-	27	8	260	No	0	0	No
Benzo(a)anthracene	340	-	1,200	8	108	Yes	8	100	No
Benzo(a)pyrene	340	-	1,200	8	150	Yes	8	100	No
Benzo(b)fluoranthene	340	-	1,200	8		N/A	0	0	No
Benzo(g,h,i)perylene	340	-	1,200	7	13	Yes	7	100	No
Benzo(k)fluoranthene	340	-	1,200	8	240	Yes	8	100	No
Benzyl Alcohol	340	-	1,200	7	1.35	Yes	7	100	No
beta-BHC	4.50	-	28	8	93.6	No	0	0	No
beta-Chlordane	4.50	-	280	4	3.24	Yes	4	100	No

Table A1.2.MKAEU.3
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Sediment in the MK AEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Max Result > ESL?	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
bis(2-Chloroethoxy) methane	340	-	1,200	8		N/A	0	0	No
bis(2-Chloroethyl) ether	340	-	1,200	8		N/A	0	0	No
bis(2-Chloroisopropyl) ether	340	-	1,200	8		N/A	0	0	No
Bromodichloromethane	5	-	27	8		N/A	0	0	No
Bromoform	5	-	27	8		N/A	0	0	No
Bromomethane	10	-	27	8	3.43	Yes	8	100	No
Butylbenzylphthalate	340	-	1,200	8	11,400	No	0	0	No
Carbazole	890	-	890	1	25.2	Yes	1	100	No
Carbon Disulfide	5	-	27	8		N/A	0	0	No
Carbon Tetrachloride	5	-	27	8	7,890	No	0	0	No
Chlorobenzene	5	-	27	8		N/A	0	0	No
Chloroethane	10	-	27	8		N/A	0	0	No
Chloroform	5	-	27	8		N/A	0	0	No
Chloromethane	10	-	27	8		N/A	0	0	No
cis-1,3-Dichloropropene	5	-	27	8		N/A	0	0	No
delta-BHC	4.50	-	28	8	2.37	Yes	8	100	No
Dibenz(a,h)anthracene	340	-	1,200	8	33	Yes	8	100	No
Dibenzofuran	340	-	1,200	8	325	Yes	8	100	No
Dibromochloromethane	5	-	27	8		N/A	0	0	No
Dieldrin	9	-	56	8	5.94	Yes	8	100	No
Diethylphthalate	340	-	1,200	8	108	Yes	8	100	No
Dimethylphthalate	340	-	1,200	8		N/A	0	0	No
Di-n-octylphthalate	340	-	1,200	8		N/A	0	0	No
Endosulfan I	4.50	-	28	8	0.690	Yes	8	100	No
Endosulfan II	9	-	56	8	0.690	Yes	8	100	No
Endosulfan sulfate	9	-	56	8	0.690	Yes	8	100	No
Endrin	9	-	56	8		N/A	0	0	No
Endrin aldehyde	9	-	9	1		N/A	0	0	No
Endrin ketone	9	-	56	8		N/A	0	0	No
Ethylbenzene	5	-	27	8	16,570	No	0	0	No
Fluorene	340	-	1,200	8	77.4	Yes	8	100	No
gamma-BHC (Lindane)	4.50	-	28	8	2.37	Yes	8	100	No
gamma-Chlordane	81	-	220	4	3.24	Yes	4	100	No
Heptachlor	4.50	-	28	8	0.132	Yes	8	100	No
Heptachlor epoxide	4.50	-	28	8	2.47	Yes	8	100	No
Hexachlorobenzene	340	-	1,200	8		N/A	0	0	No
Hexachlorobutadiene	340	-	1,200	8	23	Yes	8	100	No
Hexachlorocyclopentadiene	340	-	1,200	8		N/A	0	0	No
Hexachloroethane	340	-	1,200	8		N/A	0	0	No
Indeno(1,2,3-cd)pyrene	340	-	1,200	8	17	Yes	8	100	No
Isophorone	340	-	1,200	8		N/A	0	0	No
Methoxychlor	45	-	280	8	24	Yes	8	100	No
Methylene Chloride	6	-	28	8		N/A	0	0	No
Naphthalene	340	-	1,200	8	176	Yes	8	100	No
Nitrobenzene	340	-	1,200	8		N/A	0	0	No
N-Nitroso-di-n-propylamine	340	-	1,200	8		N/A	0	0	No
N-nitrosodiphenylamine	340	-	1,200	8		N/A	0	0	No
PCB-1016	81	-	280	8	40	Yes	8	100	No
PCB-1221	81	-	280	8	40	Yes	8	100	No
PCB-1232	81	-	280	8	40	Yes	8	100	No
PCB-1242	81	-	280	8	40	Yes	8	100	No
PCB-1248	81	-	280	8	40	Yes	8	100	No
PCB-1254	90	-	560	8	40	Yes	8	100	No
PCB-1260	90	-	560	8	40	Yes	8	100	No
Pentachlorophenol	1,700	-	5,600	8	255	Yes	8	100	No
Phenol	340	-	1,200	8	773	Yes	4	50	No
Styrene	5	-	27	8		N/A	0	0	No
Tetrachloroethene	5	-	27	8	3,050	No	0	0	No
Toxaphene	160	-	560	8		N/A	0	0	No

Table A1.2.MKAEU.3
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Sediment in the MK AEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Max Result > ESL?	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
trans-1,3-Dichloropropene	5	-	27	8		N/A	0	0	No
Trichloroethene	5	-	27	8	22,800	No	0	0	No
Vinyl acetate	10	-	18	7		N/A	0	0	No
Vinyl Chloride	10	-	27	8		N/A	0	0	No
Xylene	5	-	27	8	91	No	0	0	No

Table A1.2MKAEU.4
Summary of Professional Judgment and Ecological Risk Potential for Analytes in Sediment for the MK AEU

Analyte	Summary of Professional Judgment										Ecological Risk Potential				
	Listed as Waste Constituent for MK AEU Historical IHSSs ?[1]	Historical RFETS Inventory [2] (1974/1988) (kg)	MDC in MK AEU Surface Soil (ug/kg)	Percent Detects in MK AEU Surface Soil (%)	MDC in MK AEU Sediment (ug/kg)	Percent Detects in MK AEU Sediment (%)	MDC in Sediment Sitewide (ug/kg)	Percent Detects in Sitewide Sediment (%)	Potential to be an ECOPC?	Uncertainty Category[3]	ESL[4] (ug/kg)	LOEC [5]	Maximum Reported Result for Non-detects in SE AEU (ug/kg)	Maximum Reported Result/ LOEC[6]	Potential for Adverse Effects if Detected at Reported Results Level?
1,2,4-trichlorobenzene	No	.02/.015	NA	0	NA	0	2	0.3	No	2	429	NVA	1,200	NA	I
1,3-dichlorobenzene	No	0/.01	NA	0	NA	0	NA	0	No	1	121.52	NVA	1,200	NA	I
2,4,6-trichlorophenol	No	0/.01	NA	0	NA	0	NA	0	No	1	59.3	NVA	1,200	NA	I
2-methylnaphthalene	Yes(1)	0/.110	NA	0	NA	0	2000	3.1	Yes	3	20.2	201	1,200	6.0	Yes
4,4'DDD	No	0/.001	NA	0	NA	0	4.1	0.4	No	2	4.88	NVA	56	NA	I
4,4'DDE	No	0/.001	NA	0	NA	0	18	2.2	No	2	3.16	NVA	56	NA	I
4,4'DDT	No	0/.001	NA	0	NA	0	18	2.2	No	2	4.16	62.9	56	0.9	No
4-bromophenyl-phenylether	No	0/.005	NA	0	NA	0	NA	0	No	1	166	NVA	1,200	NA	I
acenaphthene	Yes(1)	.02/.02	NA	0	NA	0	620	14	Yes	3	6.71	89	1,200	10	Yes
acenaphthylene	Yes(1)	.02/.02	NA	0	NA	0	NA	0	No	2	5.87	NVA	1,200	NA	I
aldrin	No	0/.003	NA	0	NA	0	54	1.3	No	2	8.25	NVA	28	NA	I
alpha-chlordane	No	0/0	NA	0	NA	0	NA	0	No	1	3.24	NVA	280	NA	I
anthracene	Yes(1)	.52/.015	NA	0	NA	0	970	26	Yes	3	57.2	845	1,200	1	No
benzo(a)anthracene	Yes(1)	0/0	NA	0	NA	0	1400	43	Yes	3	108	1050	1,200	1	No
benzo(a)pyrene	Yes(1)	0/.002	NA	0	NA	0	1300	37	No	2	150	1450	1,200	0.8	No
benzo(g,h,i)perylene	Yes(1)	0/0	NA	0	NA	0	1100	25	Yes	3	13	280	1,200	4	Yes
benzo(k)fluoranthene	Yes(1)	0/0	NA	0	NA	0	1200	29	No	2	240	750	1,200	2	Yes
benzyl alcohol	No	.02/.015	NA	0	NA	0	41	0.4	No	2	1.35	NVA	1,200	NA	I
beta-chlordane	No	0/0	NA	0	NA	0	NA	0	No	2	3.24	NVA	280	NA	I
bromomethane	No	NVA	NA	0	NA	0	5	2.4	No	2	3.43	NVA	27	NA	I

Table A1.2MKAEU.4
Summary of Professional Judgment and Ecological Risk Potential for Analytes in Sediment for the MK AEU

Analyte	Summary of Professional Judgment										Ecological Risk Potential				
	Listed as Waste Constituent for MK AEU Historical IHSSs ?[1]	Historical RFETS Inventory [2] (1974/1988) (kg)	MDC in MK AEU Surface Soil (ug/kg)	Percent Detects in MK AEU Surface Soil (%)	MDC in MK AEU Sediment (ug/kg)	Percent Detects in MK AEU Sediment (%)	MDC in Sediment Sitewide (ug/kg)	Percent Detects in Sitewide Sediment (%)	Potential to be an ECOPC?	Uncertainty Category[3]	ESL[4] (ug/kg)	LOEC [5]	Maximum Reported Result for Non-detects in SE AEU (ug/kg)	Maximum Reported Result/ LOEC[6]	Potential for Adverse Effects if Detected at Reported Results Level?
carbazole	No	0/.01	NA	0	NA	0	300	38	No	2	25.2	1600	890	0.6	No
delta-BHC	No	0/0	NA	0	NA	0	13	1.3	No	2	2.37	NVA	28	NA	I
dbenz(a,h)anthracene	Yes(1)	0/.005	NA	0	NA	0	530	7.6	Yes	3	33	240	1,200	5.0	Yes
dibenzofuran	No	.02/.01	NA	0	NA	0	300	3.8	No	2	325	NVA	1,200	NA	I
dieldrin	No	0/.003	NA	0	NA	0	4.6	0.4	No	2	5.94	NVA	56	NA	I
diethylphthalate	Yes(1)	0/.03	NA	0	NA	0	79	1.0	No	2	108	NVA	1,200	NA	I
endosulfan I	No	0/.001	NA	0	NA	0	20	1.3	No	2	0.69	NVA	28	NA	I
endosulfan II	No	0/.001	NA	0	NA	0	NA	0	No	1	0.69	NVA	56	NA	I
endosulfan sulfate	No	0/.002	NA	0	NA	0	NA	0	No	1	0.69	NVA	56	NA	I
fluorene	Yes(1)	.02/.015	NA	0	NA	0	650	9.6	No	2	77.4	536	1,200	2	Yes
gamma-BHC (lindane)	No	0/.002	NA	0	NA	0	25	0.9	No	2	2.37	NVA	28	NA	I
gamma-chlordane	No	0/.003	NA	0	NA	0	NA	0	No	1	3.24	NVA	220	NA	I
heptachlor	No	0/.003	NA	0	NA	0	3.1	1.3	No	2	0.132	16	28	2	Yes
heptachlor epoxide	No	0/.001	NA	0	NA	0	33	1.3	No	2	2.47	16	28	2	Yes
hexachlorobutadiene	No	0/.005	NA	0	NA	0	2	0.3	No	2	23	NVA	1,200	NA	I
indeno(1,2,3-cd)pyrene	No	0/.005	NA	0	NA	0	910	28	Yes	3	17	250	1,200	5	Yes
methoxychlor	No	0/.002	NA	0	NA	0	2.7	0.4	No	2	24	NVA	280	NA	I
naphthalene	Yes(1)	1.8/.922	NA	0	NA	0	320	6.4	No	2	176	561	1,200	2	Yes
PCB-1016	No	0/.006	NA	0	NA	0	NA	0	No	1	40	NVA	280	NA	I
PCB-1221	No	0/.02	NA	0	NA	0	NA	0	No	1	40	NVA	280	NA	I

Table A1.2MKAEU.4
Summary of Professional Judgment and Ecological Risk Potential for Analytes in Sediment for the MK AEU

ANALYTE	SUMMARY OF PROFESSIONAL JUDGMENT										ECOLOGICAL RISK POTENTIAL				
	Listed as Waste Constituent for MK AEU Historical IHSSs ?[1]	Historical RFETS Inventory [2] (1974/1988) (kg)	MDC in MK AEU Surface Soil (ug/kg)	Percent Detects in MK AEU Surface Soil (%)	MDC in MK AEU Sediment (ug/kg)	Percent Detects in MK AEU Sediment (%)	MDC in Sediment Sitewide (ug/kg)	Percent Detects in Sitewide Sediment (%)	Potential to be an ECOPC?	Uncertainty Category[3]	ESL[4] (ug/kg)	LOEC [5]	Maximum Reported Result for Non-detects in SE AEU (ug/kg)	Maximum Reported Result/ LOEC[6]	Potential for Adverse Effects if Detected at Reported Results Level?
PCB-1232	No	0/.007	NA	0	NA	0	NA	0	No	1	40	NVA	280	NA	I
PCB-1242	No	0/.02	NA	0	NA	0	NA	0	No	1	40	NVA	280	NA	I
PCB-1248	No	0/.007	NA	0	NA	0	NA	0	No	1	40	NVA	280	NA	I
PCB-1254	No	0/.017	NA	0	NA	0	5200	23	No	2	40	300	560	2	Yes
PCB-1260	No	0/.018	NA	0	NA	0	2000	2.3	No	2	40	NVA	560	NA	I
pentachlorophenol	No	.02/.02	NA	0	NA	0	1500	2.1	No	2	255	360	5,600	20	Yes
phenol	No	.02/.01	NA	0	NA	0	150	1.7	No	2	773	NVA	1,200	NA	I

[1] Includes listing of the class of compound, e.g., herbicides, pesticides, chlorinated solvents, polynuclear aromatic hydrocarbons, etc. Ref. DOE, 2005b.
[2] CDH, 1991.
[3] See text for explanation.
[4] Basis for the NOEC.
[5] LOECs developed as described in Attachment 5 to Appendix A, Volumes 15B1 and 15B2 of the RI/FS report.
[6] Ratio is rounded to one significant figure.

(1) Oils were spayed on PAC 000-501, Roadway Spraying. The oils are not expected to contain PCBs but may have contain polynuclear aromatic hydrocarbons and phthalates.

CDH – Colorado Department of Health
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
DOE – Department of Energy
ESL – Ecological Screening Level
IHSS – Individual Hazardous Substance Site
LOEC –Lowest Observed Effect Concentration
NOEC - No Observed Effect Concentration
MDC – Maximum Detected Concentration
MK AEU – McKay Ditch Aquatic Exposure Unit
PCB – Polychlorinated Biphenyl
RFETS – Rocky Flats Environmental Technology Site

I - Inconclusive
NA – Not applicable
NVA – No value available

Table A1.2.SEAEU.1
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Water in the SE AEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Inorganics (Dissolved) (mg/L)								
Arsenic	7.00E-04	-	0.00200	6	0.150	0	0	No
Beryllium	5.00E-04	-	0.00160	7	0.00240	0	0	No
Cadmium	0.00100	-	0.00460	7	2.50E-04	7	100	No
Chromium	0.00200	-	0.00550	7	0.0740	0	0	No
Cobalt	0.00200	-	0.00730	7	0.100	0	0	No
Cyanide		-		0	5.00E-04	0	0	No
Mercury	1.00E-04	-	2.00E-04	7	7.70E-04	0	0	No
Nitrite		-		0	4.47	0	0	No
Ortho-phosphate		-		0		0	0	No
Thallium	0.00100	-	0.00200	6	0.0150	0	0	No
Uranium		-		0	1.50	0	0	No
Vanadium	0.00200	-	0.00650	7	0.0120	0	0	No
Inorganics (Total) (mg/L)								
Arsenic	7.00E-04	-	0.00370	10	0.150	0	0	No
Beryllium	5.00E-04	-	0.00100	12	0.00240	0	0	No
Cadmium	3.80E-04	-	0.00460	11	2.50E-04	11	100	No
Chromium	0.00120	-	0.00550	12	0.0740	0	0	No
Cobalt	9.10E-04	-	0.00730	12	0.100	0	0	No
Cyanide	0.00100	-	0.0100	7	5.00E-04	7	100	No
Mercury	4.40E-05	-	2.00E-04	12	7.70E-04	0	0	No
Nitrite	0.0200	-	0.0500	7	4.47	0	0	No
Ortho-phosphate	0.0500	-	0.0500	2		0	0	No
Thallium	0.00100	-	0.00430	12	0.0150	0	0	No
Uranium	0.00780	-	0.0300	4	1.50	0	0	No
Vanadium	0.00200	-	0.00650	12	0.0120	0	0	No
Organics (Total) (ug/L)								
1,1,1,2-Tetrachloroethane	0.100	-	0.100	1		0	0	No
1,1,1-Trichloroethane	0.100	-	5	7	89	0	0	No
1,1,2,2-Tetrachloroethane	0.100	-	5	7	2,400	0	0	No
1,1,2-Trichloroethane	0.100	-	5	7	940	0	0	No
1,1-Dichloroethane	0.200	-	5	7	740	0	0	No
1,1-Dichloroethene	0.200	-	5	7	65	0	0	No
1,1-Dichloropropene	0.100	-	0.100	1		0	0	No
1,2,3-Trichlorobenzene	0.100	-	0.100	1	8	0	0	No
1,2,3-Trichloropropane	0.100	-	0.100	1		0	0	No
1,2,4-Trichlorobenzene	0.100	-	0.100	1	50	0	0	No
1,2,4-Trimethylbenzene	0.100	-	0.100	1	17	0	0	No
1,2-Dibromo-3-chloropropane	2	-	2	1		0	0	No
1,2-Dibromoethane	0.500	-	0.500	1		0	0	No
1,2-Dichlorobenzene	0.100	-	0.100	1	13	0	0	No
1,2-Dichloroethane	0.100	-	5	7	20,000	0	0	No
1,2-Dichloroethene	5	-	5	7	1,100	0	0	No
1,2-Dichloropropane	0.100	-	5	7	5,700	0	0	No
1,3,5-Trimethylbenzene	0.100	-	0.100	1	45	0	0	No
1,3-Dichlorobenzene	0.100	-	0.100	1	28	0	0	No
1,3-Dichloropropane	0.100	-	0.100	1		0	0	No
1,4-Dichlorobenzene	0.100	-	0.100	1	16	0	0	No
2,4,5-TP (Silvex)	0.460	-	0.460	1		0	0	No
2,4,5-Trichlorophenol	50	-	50	1		0	0	No
2,4,6-Trichlorophenol	10	-	10	1	5	1	100	No
2,4-D	0.460	-	0.460	1		0	0	No
2,4-Dichlorophenol	10	-	10	1	365	0	0	No
2,4-Dimethylphenol	10	-	10	1	212	0	0	No
2,4-Dinitrophenol	50	-	50	1		0	0	No
2,4-Dinitrotoluene	10	-	10	1		0	0	No
2,6-Dinitrotoluene	10	-	10	1		0	0	No
2378-TCDD	0.00120	-	0.00120	1		0	0	No

Table A1.2.SEAEU.1
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Water in the SE AEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
2-Butanone	10	-	10	6	2,200	0	0	No
2-Chloronaphthalene	10	-	10	1	630	0	0	No
2-Chlorophenol	10	-	10	1		0	0	No
2-Chlorotoluene	0.200	-	0.200	1		0	0	No
2-Hexanone	10	-	10	7	99	0	0	No
2-Methylnaphthalene	10	-	10	1		0	0	No
2-Methylphenol	10	-	10	1	82	0	0	No
2-Nitroaniline	50	-	50	1		0	0	No
2-Nitrophenol	10	-	10	1		0	0	No
3,3'-Dichlorobenzidine	20	-	20	1		0	0	No
3-Nitroaniline	50	-	50	1		0	0	No
4,4'-DDD	0.100	-	0.100	1	0.0600	1	100	No
4,4'-DDE	0.100	-	0.100	1	105	0	0	No
4,4'-DDT	0.100	-	0.100	1	0.00100	1	100	No
4,6-Dinitro-2-methylphenol	50	-	50	1		0	0	No
4-Bromophenyl-phenylether	10	-	10	1		0	0	No
4-Chloro-3-methylphenol	10	-	10	1		0	0	No
4-Chloroaniline	10	-	10	1		0	0	No
4-Chlorophenyl-phenyl ether	10	-	10	1		0	0	No
4-Chlorotoluene	0.200	-	0.200	1		0	0	No
4-Isopropyltoluene	0.200	-	0.200	1		0	0	No
4-Methyl-2-pentanone	10	-	10	6	170	0	0	No
4-Methylphenol	10	-	10	1	25	0	0	No
4-Nitroaniline	50	-	50	1		0	0	No
4-Nitrophenol	50	-	50	1		0	0	No
Acenaphthene	10	-	10	1	520	0	0	No
Acenaphthylene	5.92	-	5.92	1		0	0	No
Acetone	10	-	10	6	1,500	0	0	No
Aldrin	0.0510	-	0.0510	1	0.150	0	0	No
alpha-BHC	0.0510	-	0.0510	1	2.20	0	0	No
alpha-Chlordane	0.510	-	0.510	1		0	0	No
Ametryne	0.610	-	0.610	1		0	0	No
Anthracene	0.0306	-	0.0306	1	0.730	0	0	No
Atraton	0.610	-	0.610	1		0	0	No
Atrazine	0.510	-	0.510	1	7.30	0	0	No
Benzene	0.200	-	5	7	530	0	0	No
Benzo(a)anthracene	0.347	-	0.347	1	0.0270	1	100	No
Benzo(a)pyrene	0.143	-	0.143	1	0.0140	1	100	No
Benzo(b)fluoranthene	0.153	-	0.153	1		0	0	No
Benzo(g,h,i)perylene	1.53	-	1.53	1		0	0	No
Benzo(k)fluoranthene	0.0816	-	0.0816	1		0	0	No
Benzoic Acid	50	-	50	1	42	1	100	No
Benzyl Alcohol	10	-	10	1	8.60	1	100	No
beta-BHC	0.0510	-	0.0510	1	2.20	0	0	No
bis(2-Chloroethoxy) methane	10	-	10	1		0	0	No
bis(2-Chloroethyl) ether	10	-	10	1		0	0	No
bis(2-Chloroisopropyl) ether	10	-	10	1	29	0	0	No
bis(2-ethylhexyl)phthalate	10	-	10	1	28.5	0	0	No
Bromobenzene	0.200	-	0.200	1		0	0	No
Bromochloromethane	0.500	-	0.500	1		0	0	No
Bromodichloromethane	0.200	-	5	7	1,100	0	0	No
Bromoform	0.500	-	5	7	320	0	0	No
Bromomethane	1	-	10	7	35	0	0	No
Butylbenzylphthalate	10	-	10	1	67	0	0	No
Carbon Disulfide	5	-	5	7	0.920	7	100	No
Carbon Tetrachloride	0.200	-	5	7	3,520	0	0	No
Chlorobenzene	0.100	-	5	7	47	0	0	No
Chloroethane	0.500	-	10	7		0	0	No

Table A1.2.SEAEU.1
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Water in the SE AEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Chloroform	0.100	-	5	7	1,240	0	0	No
Chloromethane	0.500	-	10	7		0	0	No
Chrysene	0.530	-	0.530	1		0	0	No
cis-1,2-Dichloroethene	0.100	-	0.100	1	620	0	0	No
cis-1,3-Dichloropropene	0.100	-	5	7	244	0	0	No
delta-BHC	0.0510	-	0.0510	1	2.20	0	0	No
Dibenz(a,h)anthracene	2.45	-	2.45	1		0	0	No
Dibenzofuran	10	-	10	1	4	1	100	No
Dibromochloromethane	0.200	-	5	7		0	0	No
Dibromomethane	0.500	-	0.500	1		0	0	No
Dichlorodifluoromethane	0.500	-	0.500	1		0	0	No
Dieldrin	0.100	-	0.100	1	0.0560	1	100	No
Diethylphthalate	10	-	10	1	110	0	0	No
Dimethylphthalate	10	-	10	1		0	0	No
Di-n-butylphthalate	10	-	10	1	9.70	1	100	No
Di-n-octylphthalate	10	-	10	1		0	0	No
Endosulfan I	0.0510	-	0.0510	1	0.0560	0	0	No
Endosulfan II	0.100	-	0.100	1	0.0560	1	100	No
Endosulfan sulfate	0.100	-	0.100	1	0.0560	1	100	No
Endrin	0.100	-	0.100	1	0.0360	1	100	No
Endrin ketone	0.100	-	0.100	1	0.0360	1	100	No
Ethylbenzene	0.200	-	5	7	3,200	0	0	No
Fluoranthene	0.632	-	0.632	1	398	0	0	No
Fluorene	0.898	-	0.898	1	12	0	0	No
gamma-BHC (Lindane)	0.0510	-	0.0510	1	0.0800	0	0	No
gamma-Chlordane	0.510	-	0.510	1		0	0	No
Heptachlor	0.0510	-	0.0510	1	0.00380	1	100	No
Heptachlor epoxide	0.0510	-	0.0510	1	0.00380	1	100	No
Hexachlorobenzene	10	-	10	1		0	0	No
Hexachlorobutadiene	0.100	-	0.100	1	9.30	0	0	No
Hexachlorocyclopentadiene	10	-	10	1		0	0	No
Hexachloroethane	10	-	10	1	540	0	0	No
Indeno(1,2,3-cd)pyrene	0.785	-	0.785	1		0	0	No
Isophorone	10	-	10	1	1,300	0	0	No
Isopropylbenzene	0.200	-	0.200	1		0	0	No
m,p-Xylene	0.200	-	0.200	1	35	0	0	No
Methoxychlor	0.510	-	0.510	1		0	0	No
Naphthalene	3.88	-	3.88	1	620	0	0	No
n-Butylbenzene	0.200	-	0.200	1		0	0	No
Nitrobenzene	10	-	10	1		0	0	No
N-Nitroso-di-n-propylamine	10	-	10	1		0	0	No
N-nitrosodiphenylamine	10	-	10	1		0	0	No
n-Propylbenzene	0.200	-	0.200	1		0	0	No
o-Xylene	0.200	-	0.200	1	35	0	0	No
PCB-1016	0.510	-	0.510	1	0.0140	1	100	No
PCB-1221	0.510	-	0.510	1	0.0140	1	100	No
PCB-1232	0.510	-	0.510	1	0.0140	1	100	No
PCB-1242	0.510	-	0.510	1	0.0140	1	100	No
PCB-1248	0.510	-	0.510	1	0.0140	1	100	No
PCB-1254	1	-	1	1	0.0140	1	100	No
PCB-1260	1	-	1	1	0.0140	1	100	No
Pentachlorophenol	50	-	50	1	6.73	1	100	No
Phenanthrene	0.714	-	0.714	1	2.40	0	0	No
Phenol	10	-	10	1	2,560	0	0	No
Prometon	0.310	-	0.310	1		0	0	No
Prometryn	0.610	-	0.610	1		0	0	No
Propazine	0.310	-	0.310	1		0	0	No
Pyrene	1.84	-	1.84	1	0.0250	1	100	No

Table A1.2.SEAEU.1
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Water in the SE AEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
sec-Butylbenzene	0.200	-	0.200	1		0	0	No
Simazine	0.610	-	0.610	1	10	0	0	No
Simetryn	0.710	-	0.710	1		0	0	No
Styrene	0.100	-	5	7	160	0	0	No
Terbutryn	0.510	-	0.510	1		0	0	No
Terbutylazine	0.310	-	0.310	1		0	0	No
tert-Butylbenzene	0.200	-	0.200	1		0	0	No
Tetrachloroethene	0.100	-	5	7	840	0	0	No
Toluene	0.200	-	5	7	1,750	0	0	No
Toxaphene	1	-	1	1		0	0	No
trans-1,2-Dichloroethene	0.100	-	0.100	1	1,500	0	0	No
trans-1,3-Dichloropropene	0.100	-	5	7	244	0	0	No
Trichloroethene	0.100	-	5	7	21,900	0	0	No
Trichlorofluoromethane	0.500	-	0.500	1		0	0	No
Vinyl acetate	10	-	10	6		0	0	No
Vinyl Chloride	0.200	-	10	7	930	0	0	No
Xylene	5	-	5	7	35	0	0	No

Table A1.2.SE AEU.2
Summary of Professional Judgment and Ecological Risk Potential for Analytes in Surface Water for the SE AEU

	SUMMARY OF PROFESSIONAL JUDGMENT												ECOLOGICAL RISK POTENTIAL						
ANALYTE	Listed as Waste Constituent for SE AEU Historical IHSSs ?1	Historical RFETS Inventory [2] (1974/1988) (kg)	MDC in SE AEU Surface Soil (µg/kg)	Percent Detects in SE AEU Surface Soil (µg/kg)	MDC in SE AEU Sediment (µg/kg)	Percent Detects in SE AEU Sediment (%)	MDC in SE AEU Surface Water (µg/L)	Percent Detects in SE AEU Surface Water (%)	MDC in Surface Water Sitewide (µg/L)	Detection Frequency in Sitewide Surface Water (%)	Potential to be an ECOPC?	Uncertainty Category[3]	ESL (µg/L)[4]	Acute Effects Value[5]	Maximum Reported Result for Non-Detects in SE AEU (µg/kg)	Maximum Reported Result for Non-Detects/ ESL[6]	Potential for Chronic Effects if Detected at Maximum Reported Results Level?	Maximum Reported Result for Non-Detects/ Acute Effects Value[6]	Potential for Acute Effects if Detected at Maximum Reported Results Level?
cadmium (dissolved)7	No	100/44	1	54	0.71	100.00	NA	0	0.0483	35	Yes	3	0.00025	0.005	0.0046	18.40	Yes	0.92	No
cadmium (total)7	No	100/44	1	54	0.71	100.00	NA	0	0.0483	35	Yes	3	0.00025	0.005	0.0046	18.40	Yes	0.92	No
cyanide6	No	.06/.43	NA	0	NS	0.00	NA	0	0.026	4.8	No	2	0.0005	0.005	0.01	20.00	Yes	2.00	Yes
2,4,6-trichloropheno	No	0/.01	NA	0	NS	0.00	NA	0	NA	0	No	1	5	79	10	2.00	Yes	0.13	No
4,4'-DDD	No	0/.001	NA	0	NS	0.00	NA	0	0.1	0.6	No	2	0.06	0.6	0.1	1.67	Yes	0.17	No
4,4'-DDT	No	0/.001	NA	0	NS	0.00	NA	0	0.6	3.5	No	2	0.001	NVA	0.1	100.00	Yes	No AEV	I
benzo(a)anthracene	Yes(1)	0/0	NA	0	NS	0.00	NA	0	8	0.2	Yes	3	0.027	0.49	0.347	12.85	Yes	0.71	No
benzo(a)pyrene	Yes(1)	0/.002	NA	0	NS	0.00	NA	0	9	0.2	Yes	3	0.014	0.24	0.143	10.21	Yes	0.60	No
benzoic acid	No	0/0	NA	0	NS	0.00	NA	0	42	1.5	No	2	42	740	0.143	0.00	No	0.00	No
benzyl alcohol	No	.02/.02	NA	0	NS	0.00	NA	0	860	1.8	No	2	8.6	150	10	1.16	Yes	0.07	No
carbon disulfide	No	3.3/5.9	NA	0	NS	0.00	NA	0	8	0.3	No	2	0.92	17	5	5.43	Yes	0.29	No
dibenzofuran	No	.02/.01	NA	0	NS	0.00	NA	0	2	1	No	2	4	72	10	2.50	Yes	0.14	No
dieldrin	No	0/.003	NA	0	NS	0.00	NA	0	NA	0	No	1	0.056	0.24	0.1	1.79	Yes	0.42	No
di-n-butylphthalate	Yes(1)	0/.005	NA	0	NS	0.00	NA	0	48	16	No	2	9.7	75	10	1.03	Yes	0.13	No
endosulfan II	No	0/.001	NA	0	NS	0.00	NA	0	NA	0	No	1	0.056	NVA	0.1	1.79	Yes	No AEV	I
endosulfan sulfate	No	0/.001	NA	0	NS	0.00	NA	0	NA	0	No	1	0.056	NVA	0.1	1.79	Yes	No AEV	I
endrin	No	0/.004	NA	0	NS	0.00	NA	0	0.02	0.3	No	2	0.036	0.086	0.1	2.78	Yes	1.16	Yes
endrin ketone	No	0/0	NA	0	NS	0.00	NA	0	NA	0	No	1	0.036	NVA	0.1	2.78	Yes	No AEV	I
heptachlor	No	0/.003	NA	0	NS	0.00	NA	0	0	1	No	2	0.0038	0.52	0.051	13.42	Yes	0.10	No
heptachlor epoxide	No	0/.001	NA	0	NS	0.00	NA	0	0.05	0.3	No	2	0.0038	0.52	0.051	13.42	Yes	0.10	No
PCB-1016	No	0/.006	NA	0	NS	0.00	NA	0	NA	0	No	1	0.014	2	0.051	3.64	Yes	0.03	No
PCB-1221	No	0/.02	NA	0	NS	0.00	NA	0	NA	0	No	1	0.014	2	0.051	3.64	Yes	0.03	No
PCB-1232	No	0/.007	NA	0	NS	0.00	NA	0	NA	0	No	1	0.014	2	0.051	3.64	Yes	0.03	No
PCB-1242	No	0/.02	NA	0	NS	0.00	NA	0	NA	0	No	1	0.014	2	0.051	3.64	Yes	0.03	No
PCB-1248	No	0/.007	NA	0	NS	0.00	NA	0	NA	0	No	1	0.014	2	0.051	3.64	Yes	0.03	No
PCB-1254	No	0/.017	NA	0	NS	0.00	NA	0	24	2.3	No	2	0.014	2	1	71.43	Yes	0.50	No
PCB-1260	No	0/.02	NA	0	NS	0.00	NA	0	NA	0	No	1	0.014	2	1	71.43	Yes	0.50	No
pentachlorophenol	No	.02/.02	NA	0	NS	0.00	NA	0	5	0.4	No	2	6.7	17.4	50	7.46	Yes	2.87	Yes
pyrene	Yes(1)	.02/.02	NA	0	NS	0.00	NA	0	12	1.3	No	2	0.025	NVA	1.84	73.60	Yes	No AEV	I

[1] Includes listing of the class of compound, e.g., herbicides, pesticides, chlorinated solvents, polynuclear aromatic hydrocarbons, etc. Ref. DOE, 2005b.
[2] CDH, 1991.
[3] See text for explanation.
[4] ESLs based on chronic effects value.
[5] Chronic and acute effects values are listed in Appendix B, Table B-5, "Surface Water ESLs for Aquatic Receptors", Ref. DOE 2005a.
[6] Ratios are rounded to the one significant figure.
[7] Units - mg/L for water and mg/kg for soil/sediment.
(1) Oils were spayed on PAC 000-501, Roadway Spraying. The oils are not expected to contain PCBs but may have contained polynuclear aromatic hydrocarbons and phthalates.

CDH – Colorado Department of Health
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
DOE – Department of Energy
ESL – Ecological Screening Level
IHSS – Individual Hazardous Substance Site
MDC - Maximum Detected Concentration
SE AEU – Southeast Aquatic Exposure Unit
RFETS – Rocky Flats Environmental Technology Site

I - Inconclusive
NA – Not applicable
ND - Not detected
NS - Not sampled
No ESL – No chronic ESL available
No AEV – No acute effects level available
NVA - No value

Table A1.2.SEAEU.3
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Sediment in the SE AEU

Analyte	Range of Nondetected Reported Results			Total Number of Result	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Inorganics (mg/L)								
Antimony	0.7	-	1.7	7	2	0	0	No
Silver	0.09	-	0.42	7	1	0	0	No
Tin	1	-	4	7		0	0	No

COMPREHENSIVE RISK ASSESSMENT

NO NAME GULCH AQUATIC EXPOSURE UNIT, ROCK CREEK AQUATIC EXPOSURE UNIT, MCKAY DITCH AQUATIC EXPOSURE UNIT, SOUTHEAST AQUATIC EXPOSURE UNIT

VOLUME 15B1: ATTACHMENT 2

Data Quality Assessment

TABLE OF CONTENTS

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

AA	atomic absorption
AEU	aquatic exposure unit
ASD	Analytical Services Division
COC	contaminant of concern
CRA	Comprehensive Risk Assessment
CRDL	contract required detection limit
DAR	data adequacy report
DER	duplicate error ratio
DOE	U.S. Department of Energy
DQA	Data Quality Assessment
DQO	data quality objective
DRC	data review checklist
ECOPC	ecological contaminant of potential concern
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ESL	ecological screening level
EU	exposure unit
FD	field duplicate
HQ	hazard quotient
IAG	Interagency Agreement
ICP	inductively couple plasma
IDL	instrument detection limit

LCS	laboratory control sample
MDA	minimum detectable activity
MDL	method detection limit
MK AEU	McKay Ditch Aquatic Exposure Unit
MS	matrix spike
MSA	method of standard additions
MSD	matrix spike duplicate
N/A	not applicable
NN AEU	No Name Gulch Aquatic Exposure Unit
PARCC	precision, accuracy, representativeness, completeness, and comparability
PPT	Pipette
PRG	preliminary remediation goal
PCB	polychlorinated biphenyl
QC	quality control
RC AEU	Rock Creek Aquatic Exposure Unit
RDL	required detection limit
RFETS	Rocky Flats Environmental Technology Site
RI/FS	Remedial Investigation/Feasibility Study
RL	reporting limit
RPD	relative percent difference
SDP	standard data package
SE AEU	Southeast Aquatic Exposure Unit
SOW	Statement of Work
SVOC	semi-volatile organic compound

SWD	Soil Water Database
TCLP	Toxicity Characteristic Leaching Procedure
TIC	tentatively identified compound
V&V	verification and validation
VOC	volatile organic compound

1.0 INTRODUCTION

This document provides an assessment of the quality of the data used in the ecological risk assessments for the four aquatic exposure units (AEUs) presented in this volume of the Comprehensive Risk Assessment (CRA). The four AEUs include the No Name Gulch AEU (NN AEU), the Rock Creek AEU (RC AEU), the McKay Ditch AEU (MK AEU), and the Southeast AEU (SE AEU).

The data quality was evaluated against standard precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters by the data validator under the multiple work plans that guided the data collection over the past 15 years, as well as the requirements for the PARCC parameters provided in the CRA Methodology (DOE 2005). The details of this data quality assessment (DQA) process are presented in the Sitewide DQA contained in Appendix A, Volume 2, Attachment 2 of the Remedial Investigation/Feasibility Study (RI/FS).

As described in Section 2.0 of the Sitewide DQA, data processing steps were followed to prepare the data set used in the CRA. A total of 36,473 environmental sampling records associated with the NN AEU, were reduced to 9,954 records that were used in the NN AEU risk assessment. Of the 24,031 records associated with the RC AEU, 9,717 were used in the RC AEU CRA data set. The MK AEU CRA data set contained 4,356 of the 10,958 analytical records available from the database, and the SE AEU CRA data set utilized 1,327 of the 1,599 available records.

Of the 9,954 analytical records existing in the NN AEU CRA data set, 81 percent (8,109 records) have undergone verification or validation (V&V). The V&V review involved applying observation notes and qualifiers flags or observation notes without qualifier flags to the data. Eighty-seven percent (8,429 records) of the RC AEU data set, 79 percent (3,454 records) of the MK AEU data set, and 94 percent (1,242 records) of the SE AEU data set underwent V&V. The percentage of data in each EU that underwent V&V is presented by analyte group and matrix in Tables A2.1.0 through A2.1.3.

PARCC parameter analysis was used to determine if the data quality could affect the risk assessment decisions (i.e., have significant impact on risk calculations or selection of ecological contaminants of potential concern [ECOPCs]). In consultation with the data users and project team, the primary ways in which the PARCC parameters could impact the risk assessment decisions were identified and these include the following:

- Detect results are falsely identified as nondetects;
- Nondetect results are falsely identified as detects;
- Issues that cause detection limit uncertainty;
- Issues that cause significant overestimation of detect results; and

- Issues that cause significant underestimation of detect results.

2.0 SUMMARY OF FINDINGS

PARCC Findings

A summary of V&V observations and the associated, affected PARCC parameter is presented in Tables A2.2.0 through A2.2.3 by analyte group and matrix (i.e. sediment and surface water). Tables A2.3.0 through A2.3.3 present the percentage of the V&V data that were qualified as estimated and/or undetected also by analyte group and matrix. Approximately 15 percent of the NN AEU, 19 percent of the RC AEU, 23 percent of the MK AEU, and 17 percent of the SE AEU V&V data were qualified as estimated or undetected. Tables A2.4.0 through A2.4.3 detail the percentage of the data that were reported as detected by the laboratory, but were later qualified as undetected by the validator due to blank contamination. In general, data qualified as estimated or undetected are marked as such because of various laboratory noncompliance issues that are not serious enough to render the data unusable. The precision between field duplicate (FD)/target sample analyte pairs is summarized in Tables A2.5.0 through A2.5.3.

Of the 81 percent of the NN AEU data set that underwent V&V, 81 percent were qualified as having no QC issues and approximately 15 percent were qualified as estimated or undetected. The remaining 4 percent of the V&V data are qualified with additional flags indicating acceptable and non-estimated data such as “A”, “C”, or “E”.

Of the 87 percent of the RC AEU data set that underwent V&V, 78 percent were qualified as having no QC issues and approximately 19 percent were qualified as estimated or undetected. The remaining 3 percent of the V&V data are qualified with additional flags indicating acceptable and non-estimated data such as “A”, “C”, or “E”.

Of the 79 percent of the MK AEU data set that underwent V&V, 74 percent were qualified as having no QC issues and approximately 23 percent were qualified as estimated or undetected. The remaining 3 percent of the V&V data are qualified with additional flags indicating acceptable and non-estimated data such as “A”, “C”, or “E”.

Of the 94 percent of the SE AEU data set that underwent V&V, 79 percent were qualified as having no QC issues and approximately 17 percent were qualified as estimated or undetected. The remaining 4 percent of the V&V data are qualified with additional flags indicating acceptable and non-estimated data such as “A”, “C”, or “E”.

Rejected data comprises approximately 5 percent 9 percent of the RC AEU, 6 percent of the MK AEU, and 3 percent of the SE AEU entire V&V data sets. All rejected data were removed from the AEU CRA data sets during the data processing as described in Section 2.0 of the Sitewide DQA.

The general discussion below summarizes the data quality as presented by the data validator’s observations. The relationship between these observations and the PARCC parameters can be found in the Sitewide DQA. Several observations have no impact on data quality because they represent issues that were noted but corrected, or represent other, general observations such as missing documentation that was not required for data assessment. Approximately 9 percent of the NN AEU, 12 percent of the RC AEU, 12 percent of the MK AEU, and 18 percent of the SE AEU V&V data were marked with these V&V observations that have no affect on any of the PARCC parameters.

Of the V&V data associated with the AEUs, approximately 12 percent of the NN AEU data were noted with V&V observations related to precision. Approximately 2 percent of the RC AEU, MK AEU, and SE AEU data sets were noted for similar observations. Such V&V observations are generally related to sample matrices, although result confirmation and instrument setup observations were also noted..

Approximately 28 percent of the NN AEU, 35 percent of the RC AEU, 66 percent of the MK AEU, and 47 percent of the SE AEU data were noted for accuracy-related observations. Most observations are laboratory practice issues, although sample specific accuracy issues related to data accuracy were also noted. While the percentages of the MK and SE AEU CRA data sets that were noted for accuracy-related V&V observations are slightly elevated, it is important to note that not all observations resulted in data qualification. Tables A2.3.0 through A2.3.3 present the percentage of the AEU data set that was qualified as estimated or undetected by analyte group and matrix.

The data were determined to meet the representativeness parameter because sampling locations are spatially distributed such that contaminant randomness and bias considerations are addressed based on the site-specific history (see the Data Adequacy Report [DAR] in Appendix A, Volume 2, Attachment 3). Samples were also analyzed by the SW-846 or alpha-spectroscopy methods and results were documented as quality records according to approved procedures and guidelines (V&V).

Of the V&V data, 44 percent of the NN AEU, 41 percent of the RC AEU, 38 percent of the MK AEU, and 44 percent of the SE AEU data sets were noted for observations related to representativeness. Blank and holding time observations make up the majority of that percentage. Others include documentation, matrix, laboratory control sample (LCS), instrument set-up and sensitivity, sample preparation, and other issues. Reportable levels of target analytes were not routinely detected in the laboratory blanks greater than the laboratory RLs and samples were generally stored and preserved properly.

The CRA Methodology specifies completeness criteria based on data adequacy and these criteria and the findings are discussed in the DAR in Appendix A, Volume 2, Attachment 3 of the RI/FS. Additionally, it should be noted that little V&V data (approximately 2 to 10 percent depending on the AEU) were rejected. See Tables A2.6.0 through A2.6.3 for a summary of the V&V data that were rejected per analyte group and matrix.

Comparability of the AEU CRA data sets is ensured as all analytical results have been converted into common units. Comparability is addressed more specifically in Appendix A, Volume 2, Attachment 2 of the RI/FS.

<u>PARCC Findings Potential Impact on Data Usability</u>

PARCC parameter influence on data usability is discussed below with an emphasis on the risk assessment decisions as described in the Introduction to this document.

Tables A2.3.0 through A2.3.3 summarize the overall percentage of qualified data, independent of validation observation. These tables are used for overall guidance in selecting analyte group and matrix combinations of interest in the analysis of the risk assessment decisions, the impact on data usability is better analyzed using Tables A2.5.0 through A2.7.3, as these can be more directly related to the 5 key risk assessment decision factors described in the introduction.

A summary of FD/target sample precision information can be found in Tables A2.5.0 through A2.5.3. Where there are analyte group and matrix combinations failures that have the potential to impact risk assessment decisions, the data quality is discussed in further detail in the Sections 2.1 through 2.4 below.

Tables A2.7.0 through A2.7.3 list V&V observations where the number of observations by analyte group and matrix exceeds 5% of the associated records (see column "Percent Observed"), with the exception of those observations that were determined to have no impact on any of the PARCC parameters. Such observations are identified in Tables A2.2.0 through A2.2.3 by an "Affected PARCC Parameter" of not applicable (N/A). Additionally, in Tables A2.7.0 through A2.7.3, the analyte group and matrix is broken down further in the columns "Percent Qualified U" and "Percent Qualified J". Data qualifications that are considered to have potential impact on risk assessment decisions were reviewed and are discussed in detail in Sections 2.1 through 2.4 below. Other issues are not considered to have the potential for significant impacts on the results of the risk assessments because the uncertainty associated with these data quality issues is assumed to be less than the overall uncertainty in the risk assessment process (e.g., uncertainties such as exposure assumptions, toxicity values, and statistical methods for calculating exposure point concentrations).

2.1 No Name Gulch Aquatic Exposure Unit

Issues that have the potential to impact the NN AEU risk assessment decisions include the following:

- All dioxin and furan/surface water NN AEU V&V non-detect results were qualified as estimated and noted with V&V observations related to continuing calibration verification (CCV) criteria that were not met. While this data quality issue has the possibility to impact the accuracy of the associated data, it is important to note that not only are the associated records nondetect results, but dioxins are not expected to be present in the NNAEU. Therefore, the impact on the NN AEU is determined to be minimal.

- Approximately 13 percent of the herbicide/surface water nondetect data was qualified as estimated and noted with the V&V observation that allowed sample holding times were exceeded. While this data quality issue has the possibility to impact the representativeness of the associated data, it is important to note that not only are the associated records nondetect results, but that herbicides were never detected in NN AEU surface water. The impact on the NN AEU risk assessment is determined to be minimal.

- Fifty percent of the polychlorinated biphenyl (PCB)/sediment and 45 percent of the pesticide/sediment nodetect data sets were qualified as estimated and noted with the V&V observation that surrogate recoveries were not met. Surrogate analyses that do not meet recovery criteria have the potential to impact the accuracy of the associated data. As all associated records are nondetect results, the impact of possible false nondetect data to NN AEU risk assessment decisions was reviewed. Although no PCBs or pesticides were selected as ECOPCs in the NN AEU, and no PCBs or pesticides were even detected in NN AEU sediments, most records noted with this V&V observation were reported as nondetect at concentrations that exceed the associated sediment ESL. The noted inaccuracy is determined to contribute some uncertainty to the NN AEU risk assessment decisions.

2.2 Rock Creek Aquatic Exposure Unit

Issues that have the potential to impact the RC AEU risk assessment decisions include the following:

- 21 percent of the metal/sediment detect data were qualified as estimated and noted with V&V observations related to laboratory control sample (LCS) analyses that did not meet recovery criteria. While this data quality issue has the possibility to impact the accuracy of the associated data, it is important to note that all records noted for this V&V observation are detect results that were generally reported well above the detection limit and well below the associated sediment ESL. The impact on risk assessment decisions is determined to be minimal.

- Approximately 17 percent of the PCB/sediment and 16 percent of the pesticide/sediment data sets were qualified as estimated and noted with the V&V observation that surrogate recoveries did not meet control criteria. Surrogate analyses that do not meet recovery criteria have the potential to impact the accuracy of the associated data. As all associated records are nondetect results, the impact of possible false nondetect data to RC AEU risk assessment decisions was reviewed. Although no PCBs or pesticides were selected as ECOPCs in the RC AEU, and no PCBs or pesticides were even detected in RC AEU sediments, most records noted with this V&V observation were reported as nondetect at concentrations that exceed the associated sediment ESL. The noted inaccuracy is determined to contribute some uncertainty to the RC AEU risk assessment decisions.

- Approximately 17 percent of the PCB/sediment and 16 percent of the pesticide/sediment data sets were qualified as estimated and noted with the V&V observation that surrogate recoveries did not meet control criteria. Surrogate analyses that do not meet recovery criteria have the potential to impact the accuracy of the associated data. As all associated records are nondetect results, the impact of possible false nondetect data to RC AEU risk assessment decisions was reviewed. Although no PCBs or pesticides were selected as ECOPCs in the RC AEU, and no PCBs or pesticides were even detected in RC AEU sediments, most records noted with this V&V observation were reported as nondetect at concentrations that exceed the associated sediment ESL. The noted inaccuracy is determined to contribute some uncertainty to the RC AEU risk assessment decisions.

- Approximately 19 percent of the volatile organic compound (VOC)/sediment nondetect data that were qualified as estimated were also noted with the V&V observation that internal standard analyses did not meet criteria. While this data quality issue has the possibility to impact the accuracy of the associated data, it is important to note that no VOCs were selected as ECOPCs in the RC AEU, and the nondetect results noted for this V&V observation were generally reported well below the associated sediment ESL. The impact on the RC AEU risk assessment is determined to be minimal.

- Several V&V observations related to the wet chemistry/sediment analyte group and matrix combination resulted in data qualifications in notable percentages of the data set. It is important to note, however, that this analyte group contains general chemistry parameters such as ions/anions and alkalinity that are not directly related to site characterization. Therefore, the impact of these qualifications on risk assessment results is determined to be minimal.

2.3 McKay Ditch Aquatic Exposure Unit

Issues that have the potential to impact the MK AEU risk assessment decisions include the following:

- Substantial percentages of the PCB and pesticide sediment and surface water nondetect data sets were qualified as estimated and noted with the V&V observation that surrogate analyses did not meet recovery criteria. Surrogate analyses that do not meet recovery criteria have the potential to impact the accuracy of the associated data. As all associated records are nondetect results, the impact of possible false nondetect data to WC AEU risk assessment decisions was reviewed. Although neither PCBs nor pesticides were selected as ECOPCs in the MK AEU, and no PCBs or pesticides were detected in the MK AEU, most records noted with this V&V observation were reported as nondetect at concentrations that exceed the associated ESL. The noted inaccuracy is determined to contribute uncertainty to the MK AEU risk assessment decisions.

- Approximately 11 percent of the VOC/sediment nondetect data that were qualified as estimated were also noted with the V&V observation that surrogate analyses did not meet criteria. While this data quality issue has the possibility to impact the accuracy of the associated data, it is important to note that no VOCs were selected as ECOPCs in the MK AEU, and the results noted for this V&V observation were generally reported well below the associated sediment ESL. The impact on the MK AEU risk assessment is determined to be minimal.

- Several V&V observations related to the wet chemistry/sediment analyte group and matrix combination resulted in data qualifications in notable percentages of the data set (Table A2.7.2). It is important to note, however, that this analyte group contains general chemistry parameters such as ions/anions and alkalinity that are not directly related to site characterization. Therefore, the impact of these qualifications on risk assessment results is determined to be minimal.

2.4 Southeast Aquatic Exposure Unit

Issues that have the potential to impact the SE AEU risk assessment decisions include the following:

- Substantial percentages of the herbicide and pesticide, surface water nondetect data sets were qualified as estimated and noted with the V&V observation that CCV criteria were not met. While this data quality issue has the possibility to impact the accuracy of the associated data, it is important to note that no herbicides or pesticides were selected as ECOPCs in the SE AEU. Additionally, all records noted for this V&V observation are nondetect results that were reported at concentrations well below the associated surface water ESLs. The impact on the SE AEU is determined to be minimal.

- Approximately 11 percent of the VOC/surface water nodetect data that were qualified as estimated were also noted with the V&V observation that the allowed sample holding times were exceeded. While this data quality issue has the possibility to impact the representativeness of the associated data, it is important to note that no VOCs were selected as ECOPCs in the SE AEU, and all nondetect results noted for this V&V observation were reported well below the associated surface water ESL. The impact on the SE AEU risk assessment is determined to be minimal.

- Forty percent of all metal/sediment FD/target sample analyte pairs associated with the SE AEU failed relative percent difference (RPD) criteria (Table A2.5.3). While this data quality issue may indicate some imprecision in the associated data, it is important to note that only one FD pair associated with the SE AEU was analyzed, and all field duplicates results were reported within an order of magnitude of the associated target sample results. As no metals were selected as ECOPCs in the SE AEU, and the detected results were generally reported at concentrations well below the associated sediment ESL, the impact on SE AEU risk assessment decisions is determined to be minimal.

- Several V&V observations related to the wet chemistry/sediment analyte group and matrix combination resulted in data qualifications in notable percentages of the data set (Table A2.7.2). It is important to note, however, that this analyte group contains general chemistry parameters such as ions/anions and alkalinity that are not directly related to site characterization. Therefore, the impact of these qualifications on risk assessment results is determined to be minimal.

3.0 CONCLUSIONS

This review concludes that the quality of the data used in the NN, RC, MK, and SE AEUs is acceptable and the CRA objectives for PARCC performance have generally been met. Where either CRA Methodology or V&V guidance have not been met, the data are either flagged by the V&V process, or for those instances where the frequency of issues may influence the risk assessment decisions, the data quality issues were reviewed for potential impact on risk assessment results.

Those elements of data quality that could affect risk assessment decisions in the NN, RC, MK, and SE AEUs have been analyzed and it was concluded that most noted deviations from the PARCC parameter criteria have minimal impact on risk assessment calculations and decisions. Data inaccuracies suggested by poor surrogate recoveries in the NN and MK AEU PCB and pesticide data sets indicated possible uncertainty in the associated risk assessments for these analyte groups.

4.0 REFERENCES

DOE, 2002, Final Work Plan for the Development of the Remedial Investigation and Feasibility Study Report, Rocky Flats Environmental Technology Site, Golden, Colorado, March.

DOE, 2005. Final Comprehensive Risk Assessment Work Plan and Methodology, Environmental Restoration, Rocky Flats Environmental Technology Site, Golden, Colorado. Revision 1, September 2005.

TABLES

Table A2.1.0
NN AEU - CRA Data V&V Summary

Analyte Group	Matrix	Total No. of CRA V&V Records	Total No. of CRA Records	Percent V&V (%)
Dioxins and Furans	Surface Water	7	7	100.00
Herbicide	Sediment	16	16	100.00
Herbicide	Surface Water	16	32	50.00
Metal	Sediment	572	574	99.65
Metal	Surface Water	2,135	2,467	86.54
PCB	Sediment	42	42	100.00
PCB	Surface Water	35	49	71.43
Pesticide	Sediment	134	134	100.00
Pesticide	Surface Water	103	166	62.05
Radionuclide	Sediment	158	160	98.75
Radionuclide	Surface Water	418	512	81.64
SVOC	Sediment	937	937	100.00
SVOC	Surface Water	895	1,360	65.81
VOC	Sediment	857	857	100.00
VOC	Surface Water	1,582	2,399	65.94
Wet Chem	Sediment	19	20	95.00
Wet Chem	Surface Water	183	222	82.43
	Total	**8,109**	**9,954**	**81.46%**

Table A2.1.1
RC AEU - CRA Data V&V Summary

Analyte Group	Matrix	Total No. of CRA V&V Records	Total No. of CRA Records	Percent V&V (%)
Herbicide	Sediment	17	17	100.00
Herbicide	Surface Water	3	3	100.00
Metal	Sediment	608	608	100.00
Metal	Surface Water	3,658	4,225	86.58
PCB	Sediment	84	91	92.31
PCB	Surface Water	21	21	100.00
Pesticide	Sediment	257	277	92.78
Pesticide	Surface Water	63	63	100.00
Radionuclide	Sediment	171	175	97.71
Radionuclide	Surface Water	301	307	98.05
SVOC	Sediment	1,094	1,099	99.55
SVOC	Surface Water	180	204	88.24
VOC	Sediment	450	450	100.00
VOC	Surface Water	1,056	1,655	63.81
Wet Chem	Sediment	22	22	100.00
Wet Chem	Surface Water	444	500	88.80
	Total	**8,429**	**9,717**	**86.74%**

Table A2.1.2
MK AEU - CRA Data V&V Summary

Analyte Group	Matrix	Total No. of CRA V&V Records	Total No. of CRA Records	Percent V&V (%)
Herbicide	Sediment	7	8	87.50
Herbicide	Surface Water	1	1	100.00
Metal	Sediment	348	348	100.00
Metal	Surface Water	1,286	1,827	70.39
PCB	Sediment	35	56	62.50
PCB	Surface Water	14	21	66.67
Pesticide	Sediment	106	169	62.72
Pesticide	Surface Water	43	64	67.19
Radionuclide	Sediment	91	103	88.35
Radionuclide	Surface Water	128	264	48.48
SVOC	Sediment	405	467	86.72
SVOC	Surface Water	102	102	100.00
VOC	Sediment	298	302	98.68
VOC	Surface Water	447	447	100.00
Wet Chem	Sediment	12	13	92.31
Wet Chem	Surface Water	131	164	79.88
	Total	**3,454**	**4,356**	**79.29%**

Table A2.1.3
SE AEU - CRA Data V&V Summary

Analyte Group	Matrix	Total No. of CRA V&V Records	Total No. of CRA Records	Percent V&V (%)
Dioxins and Furans	Surface Water	1	1	100.00
Herbicide	Surface Water	4	4	100.00
Metal	Sediment	210	210	100.00
Metal	Surface Water	469	544	86.21
PCB	Surface Water	7	7	100.00
Pesticide	Surface Water	30	30	100.00
Radionuclide	Sediment	45	45	100.00
Radionuclide	Surface Water	83	83	100.00
SVOC	Surface Water	59	59	100.00
VOC	Surface Water	264	264	100.00
Wet Chem	Sediment	7	7	100.00
Wet Chem	Surface Water	63	73	86.30
	Total	**1,242**	**1,327**	**93.59%**

Table A2.2.0
NN AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Dioxins and Furans	Surface Water	Calibration	Continuing calibration verification criteria were not met	No	7	7	100.00	Accuracy
Dioxins and Furans	Surface Water	Documentation Issues	Transcription error	No	7	7	100.00	N/A
Herbicide	Sediment	Holding Times	Holding times were exceeded	No	1	16	6.25	Representativeness
Herbicide	Sediment	Matrices	MS/MSD precision criteria were not met	No	10	16	62.50	Precision
Herbicide	Surface Water	Holding Times	Holding times were exceeded	No	2	16	12.50	Representativeness
Herbicide	Surface Water	Matrices	MS/MSD precision criteria were not met	No	2	16	12.50	Precision
Herbicide	Surface Water	Sample Preparation	Samples were not properly preserved in the field	No	1	16	6.25	Representativeness
Herbicide	Surface Water	Surrogates	Surrogate recovery criteria were not met	No	1	16	6.25	Accuracy
Metal	Sediment	Blanks	Calibration verification blank contamination	No	10	572	1.75	Representativeness
Metal	Sediment	Blanks	Method, preparation, or reagent blank contamination	No	6	572	1.05	Representativeness
Metal	Sediment	Blanks	Method, preparation, or reagent blank contamination	Yes	7	572	1.22	Representativeness
Metal	Sediment	Blanks	Negative bias indicated in the blanks	No	4	572	0.70	Representativeness
Metal	Sediment	Documentation Issues	Transcription error	No	3	572	0.52	N/A
Metal	Sediment	Instrument Set-up	Interference was indicated in the interference check sample	No	2	572	0.35	Accuracy
Metal	Sediment	LCS	CRDL check sample recovery criteria were not met	No	6	572	1.05	Accuracy
Metal	Sediment	LCS	LCS recovery criteria were not met	No	12	572	2.10	Accuracy
Metal	Sediment	LCS	LCS recovery criteria were not met	Yes	26	572	4.55	Accuracy
Metal	Sediment	LCS	Low level check sample recovery criteria were not met	No	10	572	1.75	Accuracy

Table A2.2.0
NN AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Sediment	LCS	Low level check sample recovery criteria were not met	Yes	17	572	2.97	Accuracy
Metal	Sediment	Matrices	Duplicate sample precision criteria were not met	No	1	572	0.17	Precision
Metal	Sediment	Matrices	Duplicate sample precision criteria were not met	Yes	15	572	2.62	Precision
Metal	Sediment	Matrices	Post-digestion MS did not meet control criteria	No	2	572	0.35	Accuracy
Metal	Sediment	Matrices	Post-digestion MS did not meet control criteria	Yes	3	572	0.52	Accuracy
Metal	Sediment	Matrices	Predigestion MS recovery criteria were not met	No	17	572	2.97	Accuracy
Metal	Sediment	Matrices	Predigestion MS recovery criteria were not met	Yes	53	572	9.27	Accuracy
Metal	Sediment	Matrices	Predigestion MS recovery was < 30 percent	Yes	1	572	0.17	Accuracy
Metal	Sediment	Matrices	Serial dilution criteria were not met	Yes	5	572	0.87	Accuracy
Metal	Sediment	Other	IDL is older than 3 months from date of analysis	No	61	572	10.66	Accuracy
Metal	Sediment	Other	IDL is older than 3 months from date of analysis	Yes	229	572	40.03	Accuracy
Metal	Surface Water	Blanks	Calibration verification blank contamination	No	73	2,135	3.42	Representativeness
Metal	Surface Water	Blanks	Calibration verification blank contamination	Yes	9	2,135	0.42	Representativeness
Metal	Surface Water	Blanks	Method, preparation, or reagent blank contamination	No	26	2,135	1.22	Representativeness
Metal	Surface Water	Blanks	Method, preparation, or reagent blank contamination	Yes	107	2,135	5.01	Representativeness
Metal	Surface Water	Blanks	Negative bias indicated in the blanks	No	48	2,135	2.25	Representativeness

Table A2.2.0
NN AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Surface Water	Blanks	Negative bias indicated in the blanks	Yes	20	2,135	0.94	Representativeness
Metal	Surface Water	Calibration	Calibration correlation coefficient did not meet requirements	No	4	2,135	0.19	Accuracy
Metal	Surface Water	Documentation Issues	Key data fields incorrect	No	8	2,135	0.37	N/A
Metal	Surface Water	Documentation Issues	Key data fields incorrect	Yes	48	2,135	2.25	N/A
Metal	Surface Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	28	2,135	1.31	N/A
Metal	Surface Water	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	26	2,135	1.22	N/A
Metal	Surface Water	Documentation Issues	Transcription error	No	13	2,135	0.61	N/A
Metal	Surface Water	Documentation Issues	Transcription error	Yes	13	2,135	0.61	N/A
Metal	Surface Water	Holding Times	Holding times were exceeded	No	11	2,135	0.52	Representativeness
Metal	Surface Water	Holding Times	Holding times were exceeded	Yes	21	2,135	0.98	Representativeness
Metal	Surface Water	Holding Times	Holding times were grossly exceeded	Yes	1	2,135	0.05	Representativeness
Metal	Surface Water	Instrument Set-up	Interference was indicated in the interference check sample	No	2	2,135	0.09	Accuracy
Metal	Surface Water	Instrument Set-up	Interference was indicated in the interference check sample	Yes	6	2,135	0.28	Accuracy
Metal	Surface Water	LCS	CRDL check sample recovery criteria were not met	No	15	2,135	0.70	Accuracy
Metal	Surface Water	LCS	CRDL check sample recovery criteria were not met	Yes	4	2,135	0.19	Accuracy

Table A2.2.0
NN AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Surface Water	LCS	LCS recovery criteria were not met	No	1	2,135	0.05	Accuracy
Metal	Surface Water	LCS	LCS recovery criteria were not met	Yes	5	2,135	0.23	Accuracy
Metal	Surface Water	LCS	Low level check sample recovery criteria were not met	No	23	2,135	1.08	Accuracy
Metal	Surface Water	LCS	Low level check sample recovery criteria were not met	Yes	20	2,135	0.94	Accuracy
Metal	Surface Water	Matrices	Duplicate sample precision criteria were not met	No	9	2,135	0.42	Precision
Metal	Surface Water	Matrices	Duplicate sample precision criteria were not met	Yes	11	2,135	0.52	Precision
Metal	Surface Water	Matrices	LCS/LCSD precision criteria were not met	No	1	2,135	0.05	Precision
Metal	Surface Water	Matrices	Post-digestion MS did not meet control criteria	No	28	2,135	1.31	Accuracy
Metal	Surface Water	Matrices	Post-digestion MS did not meet control criteria	Yes	3	2,135	0.14	Accuracy
Metal	Surface Water	Matrices	Predigestion MS recovery criteria were not met	No	28	2,135	1.31	Accuracy
Metal	Surface Water	Matrices	Predigestion MS recovery criteria were not met	Yes	26	2,135	1.22	Accuracy
Metal	Surface Water	Matrices	Predigestion MS recovery was < 30 percent	Yes	1	2,135	0.05	Accuracy
Metal	Surface Water	Matrices	Serial dilution criteria were not met	No	2	2,135	0.09	Accuracy
Metal	Surface Water	Matrices	Serial dilution criteria were not met	Yes	30	2,135	1.41	Accuracy
Metal	Surface Water	Other	IDL is older than 3 months from date of analysis	No	24	2,135	1.12	Accuracy

Table A2.2.0
NN AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Surface Water	Other	IDL is older than 3 months from date of analysis	Yes	32	2,135	1.50	Accuracy
Metal	Surface Water	Other	QC sample frequency does not meet method requirements	Yes	2	2,135	0.09	Representativeness
Metal	Surface Water	Sample Preparation	Samples were not properly preserved in the field	No	26	2,135	1.22	Representativeness
Metal	Surface Water	Sample Preparation	Samples were not properly preserved in the field	Yes	58	2,135	2.72	Representativeness
PCB	Sediment	Surrogates	Surrogate recovery criteria were not met	No	21	42	50.00	Accuracy
Pesticide	Sediment	Holding Times	Holding times were exceeded	No	1	134	0.75	Representativeness
Pesticide	Sediment	Matrices	MS/MSD precision criteria were not met	No	10	134	7.46	Precision
Pesticide	Sediment	Surrogates	Surrogate recovery criteria were not met	No	60	134	44.78	Accuracy
Pesticide	Surface Water	Calibration	Continuing calibration verification criteria were not met	No	1	103	0.97	Accuracy
Pesticide	Surface Water	Holding Times	Holding times were exceeded	No	1	103	0.97	Representativeness
Pesticide	Surface Water	Matrices	MS/MSD precision criteria were not met	No	2	103	1.94	Precision
Pesticide	Surface Water	Sample Preparation	Samples were not properly preserved in the field	No	1	103	0.97	Representativeness
Radionuclide	Sediment	Blanks	Blank recovery criteria were not met	Yes	1	158	0.63	Representativeness
Radionuclide	Sediment	Blanks	Method, preparation, or reagent blank contamination	No	1	158	0.63	Representativeness
Radionuclide	Sediment	Blanks	Method, preparation, or reagent blank contamination	Yes	8	158	5.06	Representativeness
Radionuclide	Sediment	Calculation Errors	Calculation error	Yes	6	158	3.80	N/A
Radionuclide	Sediment	Calibration	Continuing calibration verification criteria were not met	Yes	1	158	0.63	Accuracy
Radionuclide	Sediment	Documentation Issues	Record added by the validator	Yes	2	158	1.27	N/A

Table A2.2.0
NN AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Sediment	Documentation Issues	Sufficient documentation not provided by the laboratory	No	1	158	0.63	Representativeness
Radionuclide	Sediment	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	24	158	15.19	Representativeness
Radionuclide	Sediment	Documentation Issues	Transcription error	Yes	22	158	13.92	N/A
Radionuclide	Sediment	Holding Times	Holding times were grossly exceeded	Yes	6	158	3.80	Representativeness
Radionuclide	Sediment	Instrument Set-up	Detector efficiency did not meet requirements	Yes	12	158	7.59	Accuracy
Radionuclide	Sediment	LCS	LCS recovery > +/- 3 sigma	Yes	2	158	1.27	Accuracy
Radionuclide	Sediment	LCS	LCS recovery criteria were not met	Yes	3	158	1.90	Accuracy
Radionuclide	Sediment	LCS	LCS relative percent error criteria not met	Yes	7	158	4.43	Accuracy
Radionuclide	Sediment	Matrices	Replicate precision criteria were not met	Yes	4	158	2.53	Precision
Radionuclide	Sediment	Other	Lab results not verified due to unsubmitted data	Yes	1	158	0.63	Representativeness
Radionuclide	Sediment	Other	Sample exceeded efficiency curve weight limit	Yes	1	158	0.63	Accuracy
Radionuclide	Sediment	Other	See hard copy for further explanation	Yes	10	158	6.33	N/A
Radionuclide	Sediment	Other	Tracer requirements were not met	No	1	158	0.63	Accuracy
Radionuclide	Sediment	Other	Tracer requirements were not met	Yes	2	158	1.27	Accuracy
Radionuclide	Sediment	Sensitivity	MDA was calculated by reviewer	Yes	31	158	19.62	N/A
Radionuclide	Sediment	Sensitivity	Results considered qualitative not quantitative	Yes	1	158	0.63	Accuracy
Radionuclide	Surface Water	Blanks	Blank recovery criteria were not met	No	2	418	0.48	Representativeness
Radionuclide	Surface Water	Blanks	Blank recovery criteria were not met	Yes	2	418	0.48	Representativeness
Radionuclide	Surface Water	Blanks	Method, preparation, or reagent blank contamination	Yes	27	418	6.46	Representativeness
Radionuclide	Surface Water	Calculation Errors	Calculation error	Yes	1	418	0.24	N/A

Table A2.2.0
NN AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Surface Water	Calibration	Calibration counting statistics did not meet criteria	No	1	418	0.24	Accuracy
Radionuclide	Surface Water	Calibration	Continuing calibration verification criteria were not met	No	5	418	1.20	Accuracy
Radionuclide	Surface Water	Calibration	Continuing calibration verification criteria were not met	Yes	20	418	4.78	Accuracy
Radionuclide	Surface Water	Documentation Issues	Information missing from case narrative	No	1	418	0.24	N/A
Radionuclide	Surface Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	1	418	0.24	N/A
Radionuclide	Surface Water	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	1	418	0.24	N/A
Radionuclide	Surface Water	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	108	418	25.84	Representativeness
Radionuclide	Surface Water	Documentation Issues	Transcription error	No	15	418	3.59	N/A
Radionuclide	Surface Water	Documentation Issues	Transcription error	Yes	28	418	6.70	N/A
Radionuclide	Surface Water	Holding Times	Holding times were exceeded	No	12	418	2.87	Representativeness
Radionuclide	Surface Water	Holding Times	Holding times were exceeded	Yes	27	418	6.46	Representativeness
Radionuclide	Surface Water	Holding Times	Holding times were grossly exceeded	No	2	418	0.48	Representativeness
Radionuclide	Surface Water	Holding Times	Holding times were grossly exceeded	Yes	3	418	0.72	Representativeness
Radionuclide	Surface Water	LCS	Expected LCS value not submitted/verifiable	Yes	2	418	0.48	Representativeness
Radionuclide	Surface Water	LCS	LCS recovery > +/- 3 sigma	No	2	418	0.48	Accuracy

Table A2.2.0
NN AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Surface Water	LCS	LCS recovery > +/- 3 sigma	Yes	10	418	2.39	Accuracy
Radionuclide	Surface Water	LCS	LCS relative percent error criteria not met	Yes	13	418	3.11	Accuracy
Radionuclide	Surface Water	Matrices	Recovery criteria were not met	Yes	3	418	0.72	Accuracy
Radionuclide	Surface Water	Matrices	Replicate analysis was not performed	Yes	17	418	4.07	Precision
Radionuclide	Surface Water	Matrices	Replicate precision criteria were not met	No	8	418	1.91	Precision
Radionuclide	Surface Water	Matrices	Replicate precision criteria were not met	Yes	29	418	6.94	Precision
Radionuclide	Surface Water	Other	Lab results not verified due to unsubmitted data	Yes	1	418	0.24	Representativeness
Radionuclide	Surface Water	Other	See hard copy for further explanation	No	9	418	2.15	N/A
Radionuclide	Surface Water	Other	See hard copy for further explanation	Yes	32	418	7.66	N/A
Radionuclide	Surface Water	Other	Tracer requirements were not met	No	2	418	0.48	Accuracy
Radionuclide	Surface Water	Other	Tracer requirements were not met	Yes	4	418	0.96	Accuracy
Radionuclide	Surface Water	Sensitivity	Incorrect reported activity or MDA	No	1	418	0.24	N/A
Radionuclide	Surface Water	Sensitivity	MDA exceeded the RDL	No	6	418	1.44	Representativeness
Radionuclide	Surface Water	Sensitivity	MDA exceeded the RDL	Yes	11	418	2.63	Representativeness
Radionuclide	Surface Water	Sensitivity	MDA was calculated by reviewer	Yes	102	418	24.40	N/A

Table A2.2.0
NN AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
SVOC	Sediment	Blanks	Method, preparation, or reagent blank contamination	No	7	937	0.75	Representativeness
SVOC	Sediment	Blanks	Method, preparation, or reagent blank contamination	Yes	3	937	0.32	Representativeness
SVOC	Sediment	Calibration	Continuing calibration verification criteria were not met	No	10	937	1.07	Accuracy
SVOC	Sediment	Calibration	Continuing calibration verification criteria were not met	Yes	1	937	0.11	Accuracy
SVOC	Sediment	Holding Times	Holding times were exceeded	No	58	937	6.19	Representativeness
SVOC	Sediment	Holding Times	Holding times were exceeded	Yes	1	937	0.11	Representativeness
SVOC	Sediment	Matrices	MS/MSD precision criteria were not met	No	531	937	56.67	Precision
SVOC	Sediment	Matrices	MS/MSD precision criteria were not met	Yes	29	937	3.09	Precision
SVOC	Surface Water	Calibration	Continuing calibration verification criteria were not met	No	5	895	0.56	Accuracy
SVOC	Surface Water	Calibration	Independent calibration verification criteria not met	No	1	895	0.11	Accuracy
SVOC	Surface Water	Calibration	Independent calibration verification criteria not met	Yes	1	895	0.11	Accuracy
SVOC	Surface Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	9	895	1.01	N/A
SVOC	Surface Water	Holding Times	Holding times were exceeded	No	82	895	9.16	Representativeness
SVOC	Surface Water	Holding Times	Holding times were exceeded	Yes	5	895	0.56	Representativeness
SVOC	Surface Water	Instrument Set-up	Instrument tune criteria were not met	No	3	895	0.34	Accuracy
SVOC	Surface Water	LCS	LCS recovery criteria were not met	No	1	895	0.11	Accuracy
SVOC	Surface Water	Matrices	MS/MSD precision criteria were not met	No	111	895	12.40	Precision

Table A2.2.0
NN AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
SVOC	Surface Water	Matrices	MS/MSD precision criteria were not met	Yes	1	895	0.11	Precision
SVOC	Surface Water	Sample Preparation	Samples were not properly preserved in the field	No	60	895	6.70	Representativeness
SVOC	Surface Water	Surrogates	Surrogate recovery criteria were not met	No	13	895	1.45	Accuracy
SVOC	Surface Water	Surrogates	Surrogate recovery criteria were not met	Yes	18	895	2.01	Accuracy
VOC	Sediment	Blanks	Method, preparation, or reagent blank contamination	No	10	857	1.17	Representativeness
VOC	Sediment	Blanks	Method, preparation, or reagent blank contamination	Yes	10	857	1.17	Representativeness
VOC	Sediment	Holding Times	Holding times were exceeded	No	4	857	0.47	Representativeness
VOC	Sediment	Internal Standards	Internal standards did not meet criteria	No	21	857	2.45	Accuracy
VOC	Sediment	Matrices	MS/MSD precision criteria were not met	No	20	857	2.33	Precision
VOC	Sediment	Surrogates	Surrogate recovery criteria were not met	No	34	857	3.97	Accuracy
VOC	Surface Water	Blanks	Method, preparation, or reagent blank contamination	No	18	1,582	1.14	Representativeness
VOC	Surface Water	Blanks	Method, preparation, or reagent blank contamination	Yes	5	1,582	0.32	Representativeness
VOC	Surface Water	Calculation Errors	Calculation error	Yes	1	1,582	0.06	N/A
VOC	Surface Water	Calibration	Continuing calibration verification criteria were not met	No	21	1,582	1.33	Accuracy
VOC	Surface Water	Calibration	Independent calibration verification criteria not met	No	8	1,582	0.51	Accuracy
VOC	Surface Water	Calibration	Independent calibration verification criteria not met	Yes	1	1,582	0.06	Accuracy
VOC	Surface Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	165	1,582	10.43	N/A

Table A2.2.0
NN AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
VOC	Surface Water	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	4	1,582	0.25	N/A
VOC	Surface Water	Documentation Issues	Original documentation not provided	Yes	1	1,582	0.06	N/A
VOC	Surface Water	Documentation Issues	Record added by the validator	No	34	1,582	2.15	N/A
VOC	Surface Water	Holding Times	Holding times were exceeded	No	156	1,582	9.86	Representativeness
VOC	Surface Water	Holding Times	Holding times were exceeded	Yes	4	1,582	0.25	Representativeness
VOC	Surface Water	Instrument Set-up	Instrument tune criteria were not met	No	54	1,582	3.41	Accuracy
VOC	Surface Water	Internal Standards	Internal standards did not meet criteria	No	35	1,582	2.21	Accuracy
VOC	Surface Water	LCS	LCS recovery criteria were not met	No	33	1,582	2.09	Accuracy
VOC	Surface Water	Matrices	MS/MSD precision criteria were not met	No	61	1,582	3.86	Precision
VOC	Surface Water	Matrices	MS/MSD precision criteria were not met	Yes	2	1,582	0.13	Precision
VOC	Surface Water	Other	Sample results were not validated due to re-analysis	No	32	1,582	2.02	N/A
VOC	Surface Water	Other	Sample results were not validated due to re-analysis	Yes	1	1,582	0.06	N/A
VOC	Surface Water	Other	See hard copy for further explanation	Yes	1	1,582	0.06	N/A
VOC	Surface Water	Sample Preparation	Samples were not properly preserved in the field	No	62	1,582	3.92	Representativeness
Wet Chem	Sediment	Holding Times	Holding times were exceeded	Yes	1	19	5.26	Representativeness
Wet Chem	Sediment	Other	IDL is older than 3 months from date of analysis	Yes	10	19	52.63	Accuracy

Table A2.2.0
NN AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Wet Chem	Surface Water	Documentation Issues	Record added by the validator	No	1	183	0.55	N/A
Wet Chem	Surface Water	Documentation Issues	Transcription error	Yes	1	183	0.55	N/A
Wet Chem	Surface Water	Holding Times	Holding times were exceeded	No	4	183	2.19	Representativeness
Wet Chem	Surface Water	Holding Times	Holding times were exceeded	Yes	8	183	4.37	Representativeness
Wet Chem	Surface Water	Holding Times	Holding times were grossly exceeded	No	2	183	1.09	Representativeness
Wet Chem	Surface Water	Matrices	Predigestion MS recovery criteria were not met	No	1	183	0.55	Accuracy
Wet Chem	Surface Water	Matrices	Predigestion MS recovery criteria were not met	Yes	4	183	2.19	Accuracy
Wet Chem	Surface Water	Matrices	Predigestion MS recovery was < 30 percent	Yes	1	183	0.55	Accuracy
Wet Chem	Surface Water	Other	Lab results not verified due to unsubmitted data	Yes	1	183	0.55	Representativeness
Wet Chem	Surface Water	Other	Result obtained through dilution	Yes	4	183	2.19	N/A

Table A2.2.1
RC AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Herbicide	Sediment	Surrogates	Surrogate recovery criteria were not met	No	1	17	5.88	Accuracy
Metal	Sediment	Blanks	Calibration verification blank contamination	No	9	608	1.48	Representativeness
Metal	Sediment	Blanks	Method, preparation, or reagent blank contamination	No	11	608	1.81	Representativeness
Metal	Sediment	Blanks	Method, preparation, or reagent blank contamination	Yes	23	608	3.78	Representativeness
Metal	Sediment	Blanks	Negative bias indicated in the blanks	No	3	608	0.49	Representativeness
Metal	Sediment	Blanks	Negative bias indicated in the blanks	Yes	8	608	1.32	Representativeness
Metal	Sediment	Calibration	Calibration correlation coefficient did not meet requirements	Yes	2	608	0.33	Accuracy
Metal	Sediment	Documentation Issues	Transcription error	Yes	3	608	0.49	N/A
Metal	Sediment	LCS	CRDL check sample recovery criteria were not met	No	2	608	0.33	Accuracy
Metal	Sediment	LCS	CRDL check sample recovery criteria were not met	Yes	3	608	0.49	Accuracy
Metal	Sediment	LCS	LCS recovery criteria were not met	No	38	608	6.25	Accuracy
Metal	Sediment	LCS	LCS recovery criteria were not met	Yes	131	608	21.55	Accuracy
Metal	Sediment	LCS	Low level check sample recovery criteria were not met	No	10	608	1.64	Accuracy
Metal	Sediment	LCS	Low level check sample recovery criteria were not met	Yes	9	608	1.48	Accuracy
Metal	Sediment	Matrices	Duplicate sample precision criteria were not met	Yes	16	608	2.63	Precision
Metal	Sediment	Matrices	LCS/LCSD precision criteria were not met	Yes	5	608	0.82	Precision
Metal	Sediment	Matrices	MSA calibration correlation coefficient < 0.995	Yes	1	608	0.16	Accuracy
Metal	Sediment	Matrices	Percent solids < 30 percent	Yes	48	608	7.89	Representativeness
Metal	Sediment	Matrices	Post-digestion MS did not meet control criteria	No	2	608	0.33	Accuracy

Table A2.2.1
RC AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Sediment	Matrices	Post-digestion MS did not meet control criteria	Yes	4	608	0.66	Accuracy
Metal	Sediment	Matrices	Predigestion MS recovery criteria were not met	No	17	608	2.80	Accuracy
Metal	Sediment	Matrices	Predigestion MS recovery criteria were not met	Yes	30	608	4.93	Accuracy
Metal	Sediment	Matrices	Predigestion MS recovery was < 30 percent	Yes	2	608	0.33	Accuracy
Metal	Sediment	Matrices	Serial dilution criteria were not met	Yes	12	608	1.97	Accuracy
Metal	Sediment	Other	Result obtained through dilution	Yes	1	608	0.16	N/A
Metal	Surface Water	Blanks	Calibration verification blank contamination	No	153	3,658	4.18	Representativeness
Metal	Surface Water	Blanks	Calibration verification blank contamination	Yes	21	3,658	0.57	Representativeness
Metal	Surface Water	Blanks	Method, preparation, or reagent blank contamination	No	57	3,658	1.56	Representativeness
Metal	Surface Water	Blanks	Method, preparation, or reagent blank contamination	Yes	155	3,658	4.24	Representativeness
Metal	Surface Water	Blanks	Negative bias indicated in the blanks	No	66	3,658	1.80	Representativeness
Metal	Surface Water	Blanks	Negative bias indicated in the blanks	Yes	23	3,658	0.63	Representativeness
Metal	Surface Water	Calculation Errors	Control limits not assigned correctly	Yes	2	3,658	0.05	N/A
Metal	Surface Water	Calibration	Calibration correlation coefficient did not meet requirements	No	7	3,658	0.19	Accuracy
Metal	Surface Water	Calibration	Calibration correlation coefficient did not meet requirements	Yes	4	3,658	0.11	Accuracy
Metal	Surface Water	Calibration	Continuing calibration verification criteria were not met	Yes	1	3,658	0.03	Accuracy

Table A2.2.1
RC AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Surface Water	Calibration	Frequency or sequencing verification criteria not met	No	13	3,658	0.36	Accuracy
Metal	Surface Water	Calibration	Frequency or sequencing verification criteria not met	Yes	21	3,658	0.57	Accuracy
Metal	Surface Water	Documentation Issues	Key data fields incorrect	No	6	3,658	0.16	N/A
Metal	Surface Water	Documentation Issues	Key data fields incorrect	Yes	36	3,658	0.98	N/A
Metal	Surface Water	Documentation Issues	Missing deliverables (not required for validation)	No	41	3,658	1.12	N/A
Metal	Surface Water	Documentation Issues	Missing deliverables (not required for validation)	Yes	45	3,658	1.23	N/A
Metal	Surface Water	Documentation Issues	Missing deliverables (required for validation)	No	23	3,658	0.63	Representativeness
Metal	Surface Water	Documentation Issues	Missing deliverables (required for validation)	Yes	32	3,658	0.87	Representativeness
Metal	Surface Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	70	3,658	1.91	N/A
Metal	Surface Water	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	179	3,658	4.89	N/A
Metal	Surface Water	Documentation Issues	Omissions or errors in data package (required for validation)	No	1	3,658	0.03	Representativeness
Metal	Surface Water	Documentation Issues	Transcription error	No	65	3,658	1.78	N/A
Metal	Surface Water	Documentation Issues	Transcription error	Yes	46	3,658	1.26	N/A
Metal	Surface Water	Holding Times	Holding times were exceeded	No	6	3,658	0.16	Representativeness
Metal	Surface Water	Holding Times	Holding times were grossly exceeded	Yes	1	3,658	0.03	Representativeness

Table A2.2.1
RC AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Surface Water	Instrument Set-up	Interference was indicated in the interference check sample	No	4	3,658	0.11	Accuracy
Metal	Surface Water	Instrument Set-up	Interference was indicated in the interference check sample	Yes	8	3,658	0.22	Accuracy
Metal	Surface Water	LCS	CRDL check sample recovery criteria were not met	No	30	3,658	0.82	Accuracy
Metal	Surface Water	LCS	CRDL check sample recovery criteria were not met	Yes	15	3,658	0.41	Accuracy
Metal	Surface Water	LCS	LCS recovery criteria were not met	No	28	3,658	0.77	Accuracy
Metal	Surface Water	LCS	LCS recovery criteria were not met	Yes	66	3,658	1.80	Accuracy
Metal	Surface Water	LCS	Low level check sample recovery criteria were not met	No	40	3,658	1.09	Accuracy
Metal	Surface Water	LCS	Low level check sample recovery criteria were not met	Yes	27	3,658	0.74	Accuracy
Metal	Surface Water	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	No	11	3,658	0.30	Representativeness
Metal	Surface Water	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	Yes	15	3,658	0.41	Representativeness
Metal	Surface Water	Matrices	Duplicate sample precision criteria were not met	No	2	3,658	0.05	Precision
Metal	Surface Water	Matrices	Duplicate sample precision criteria were not met	Yes	11	3,658	0.30	Precision
Metal	Surface Water	Matrices	LCS/LCSD precision criteria were not met	No	6	3,658	0.16	Precision
Metal	Surface Water	Matrices	LCS/LCSD precision criteria were not met	Yes	15	3,658	0.41	Precision
Metal	Surface Water	Matrices	MSA calibration correlation coefficient < 0.995	No	1	3,658	0.03	Accuracy

Table A2.2.1
RC AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Surface Water	Matrices	Post-digestion MS did not meet control criteria	No	21	3,658	0.57	Accuracy
Metal	Surface Water	Matrices	Post-digestion MS did not meet control criteria	Yes	6	3,658	0.16	Accuracy
Metal	Surface Water	Matrices	Predigestion MS recovery criteria were not met	No	35	3,658	0.96	Accuracy
Metal	Surface Water	Matrices	Predigestion MS recovery criteria were not met	Yes	62	3,658	1.69	Accuracy
Metal	Surface Water	Matrices	Serial dilution criteria were not met	No	4	3,658	0.11	Accuracy
Metal	Surface Water	Matrices	Serial dilution criteria were not met	Yes	83	3,658	2.27	Accuracy
Metal	Surface Water	Other	IDL is older than 3 months from date of analysis	No	80	3,658	2.19	Accuracy
Metal	Surface Water	Other	IDL is older than 3 months from date of analysis	Yes	59	3,658	1.61	Accuracy
Metal	Surface Water	Sample Preparation	Samples were not properly preserved in the field	No	37	3,658	1.01	Representativeness
Metal	Surface Water	Sample Preparation	Samples were not properly preserved in the field	Yes	72	3,658	1.97	Representativeness
PCB	Sediment	Documentation Issues	Transcription error	No	14	84	16.67	N/A
PCB	Sediment	Other	See hard copy for further explanation	No	7	84	8.33	N/A
PCB	Sediment	Surrogates	Surrogate recovery criteria were not met	No	14	84	16.67	Accuracy
Pesticide	Sediment	Other	See hard copy for further explanation	No	20	257	7.78	N/A
Pesticide	Sediment	Surrogates	Surrogate recovery criteria were not met	No	41	257	15.95	Accuracy
Radionuclide	Sediment	Blanks	Method, preparation, or reagent blank contamination	No	1	171	0.58	Representativeness
Radionuclide	Sediment	Blanks	Method, preparation, or reagent blank contamination	Yes	22	171	12.87	Representativeness
Radionuclide	Sediment	Calculation Errors	Calculation error	Yes	4	171	2.34	N/A

Table A2.2.1
RC AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Sediment	Calibration	Continuing calibration verification criteria were not met	Yes	4	171	2.34	Accuracy
Radionuclide	Sediment	Documentation Issues	Results were not included on Data Summary Table	Yes	1	171	0.58	N/A
Radionuclide	Sediment	Documentation Issues	Sufficient documentation not provided by the laboratory	No	2	171	1.17	Representativeness
Radionuclide	Sediment	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	30	171	17.54	Representativeness
Radionuclide	Sediment	Documentation Issues	Transcription error	No	2	171	1.17	N/A
Radionuclide	Sediment	Documentation Issues	Transcription error	Yes	28	171	16.37	N/A
Radionuclide	Sediment	Holding Times	Holding times were grossly exceeded	Yes	6	171	3.51	Representativeness
Radionuclide	Sediment	Instrument Set-up	Detector efficiency did not meet requirements	Yes	8	171	4.68	Accuracy
Radionuclide	Sediment	Instrument Set-up	Resolution criteria were not met	Yes	1	171	0.58	Representativeness
Radionuclide	Sediment	LCS	LCS recovery > +/- 3 sigma	Yes	9	171	5.26	Accuracy
Radionuclide	Sediment	LCS	LCS recovery criteria were not met	No	1	171	0.58	Accuracy
Radionuclide	Sediment	LCS	LCS relative percent error criteria not met	No	1	171	0.58	Accuracy
Radionuclide	Sediment	LCS	LCS relative percent error criteria not met	Yes	6	171	3.51	Accuracy
Radionuclide	Sediment	Matrices	Recovery criteria were not met	Yes	2	171	1.17	Accuracy
Radionuclide	Sediment	Matrices	Replicate analysis was not performed	Yes	1	171	0.58	Precision
Radionuclide	Sediment	Matrices	Replicate precision criteria were not met	No	1	171	0.58	Precision
Radionuclide	Sediment	Matrices	Replicate precision criteria were not met	Yes	5	171	2.92	Precision
Radionuclide	Sediment	Other	Lab results not verified due to unsubmitted data	Yes	4	171	2.34	Representativeness
Radionuclide	Sediment	Other	Sample exceeded efficiency curve weight limit	Yes	4	171	2.34	Accuracy
Radionuclide	Sediment	Other	See hard copy for further explanation	No	1	171	0.58	N/A
Radionuclide	Sediment	Other	See hard copy for further explanation	Yes	19	171	11.11	N/A
Radionuclide	Sediment	Sensitivity	Incorrect reported activity or MDA	No	1	171	0.58	N/A

Table A2.2.1
RC AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Sediment	Sensitivity	MDA exceeded the RDL	No	3	171	1.75	Representativeness
Radionuclide	Sediment	Sensitivity	MDA exceeded the RDL	Yes	7	171	4.09	Representativeness
Radionuclide	Sediment	Sensitivity	MDA was calculated by reviewer	Yes	60	171	35.09	N/A
Radionuclide	Sediment	Sensitivity	Results considered qualitative not quantitative	Yes	4	171	2.34	Accuracy
Radionuclide	Surface Water	Blanks	Method, preparation, or reagent blank contamination	No	6	301	1.99	Representativeness
Radionuclide	Surface Water	Blanks	Method, preparation, or reagent blank contamination	Yes	19	301	6.31	Representativeness
Radionuclide	Surface Water	Calibration	Calibration counting statistics did not meet criteria	No	2	301	0.66	Accuracy
Radionuclide	Surface Water	Calibration	Continuing calibration verification criteria were not met	No	6	301	1.99	Accuracy
Radionuclide	Surface Water	Calibration	Continuing calibration verification criteria were not met	Yes	26	301	8.64	Accuracy
Radionuclide	Surface Water	Documentation Issues	Missing deliverables (required for validation)	No	1	301	0.33	Representativeness
Radionuclide	Surface Water	Documentation Issues	Missing deliverables (required for validation)	Yes	1	301	0.33	Representativeness
Radionuclide	Surface Water	Documentation Issues	No raw data submitted by the laboratory	Yes	1	301	0.33	Representativeness
Radionuclide	Surface Water	Documentation Issues	Record added by the validator	Yes	4	301	1.33	N/A
Radionuclide	Surface Water	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	58	301	19.27	Representativeness
Radionuclide	Surface Water	Documentation Issues	Transcription error	No	16	301	5.32	N/A
Radionuclide	Surface Water	Documentation Issues	Transcription error	Yes	44	301	14.62	N/A
Radionuclide	Surface Water	Holding Times	Holding times were exceeded	No	10	301	3.32	Representativeness

Table A2.2.1
RC AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Surface Water	Holding Times	Holding times were exceeded	Yes	12	301	3.99	Representativeness
Radionuclide	Surface Water	Holding Times	Holding times were grossly exceeded	No	3	301	1.00	Representativeness
Radionuclide	Surface Water	LCS	Expected LCS value not submitted/verifiable	Yes	1	301	0.33	Representativeness
Radionuclide	Surface Water	LCS	LCS recovery > +/- 3 sigma	No	8	301	2.66	Accuracy
Radionuclide	Surface Water	LCS	LCS recovery > +/- 3 sigma	Yes	7	301	2.33	Accuracy
Radionuclide	Surface Water	LCS	LCS recovery criteria were not met	No	1	301	0.33	Accuracy
Radionuclide	Surface Water	LCS	LCS relative percent error criteria not met	No	3	301	1.00	Accuracy
Radionuclide	Surface Water	LCS	LCS relative percent error criteria not met	Yes	15	301	4.98	Accuracy
Radionuclide	Surface Water	Matrices	Recovery criteria were not met	No	1	301	0.33	Accuracy
Radionuclide	Surface Water	Matrices	Recovery criteria were not met	Yes	2	301	0.66	Accuracy
Radionuclide	Surface Water	Matrices	Replicate analysis was not performed	Yes	7	301	2.33	Precision
Radionuclide	Surface Water	Matrices	Replicate precision criteria were not met	No	14	301	4.65	Precision
Radionuclide	Surface Water	Matrices	Replicate precision criteria were not met	Yes	19	301	6.31	Precision
Radionuclide	Surface Water	Matrices	Replicate recovery criteria were not met	Yes	4	301	1.33	Accuracy
Radionuclide	Surface Water	Other	Lab results not verified due to unsubmitted data	Yes	6	301	1.99	Representativeness

Table A2.2.1
RC AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Surface Water	Other	Sample results were not validated due to re-analysis	No	1	301	0.33	N/A
Radionuclide	Surface Water	Other	Sample results were not validated due to re-analysis	Yes	2	301	0.66	N/A
Radionuclide	Surface Water	Other	See hard copy for further explanation	No	9	301	2.99	N/A
Radionuclide	Surface Water	Other	See hard copy for further explanation	Yes	23	301	7.64	N/A
Radionuclide	Surface Water	Sensitivity	MDA exceeded the RDL	No	3	301	1.00	Representativeness
Radionuclide	Surface Water	Sensitivity	MDA exceeded the RDL	Yes	4	301	1.33	Representativeness
Radionuclide	Surface Water	Sensitivity	MDA was calculated by reviewer	Yes	81	301	26.91	N/A
SVOC	Sediment	Blanks	Method, preparation, or reagent blank contamination	No	4	1,094	0.37	Representativeness
SVOC	Sediment	Calibration	Continuing calibration verification criteria were not met	No	10	1,094	0.91	Accuracy
SVOC	Sediment	Calibration	Continuing calibration verification criteria were not met	Yes	3	1,094	0.27	Accuracy
SVOC	Sediment	Internal Standards	Internal standards did not meet criteria	No	22	1,094	2.01	Accuracy
SVOC	Sediment	Internal Standards	Internal standards did not meet criteria	Yes	5	1,094	0.46	Accuracy
SVOC	Sediment	Matrices	Percent solids < 30 percent	Yes	3	1,094	0.27	Representativeness
SVOC	Sediment	Surrogates	Surrogate recovery criteria were not met	No	56	1,094	5.12	Accuracy
SVOC	Sediment	Surrogates	Surrogate recovery criteria were not met	Yes	1	1,094	0.09	Accuracy
SVOC	Surface Water	Calibration	Continuing calibration verification criteria were not met	No	1	180	0.56	Accuracy
VOC	Sediment	Blanks	Method, preparation, or reagent blank contamination	No	14	450	3.11	Representativeness
VOC	Sediment	Calibration	Continuing calibration verification criteria were not met	Yes	9	450	2.00	Accuracy

Table A2.2.1
RC AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
VOC	Sediment	Documentation Issues	Transcription error	No	12	450	2.67	N/A
VOC	Sediment	Internal Standards	Internal standards did not meet criteria	No	85	450	18.89	Accuracy
VOC	Sediment	Internal Standards	Internal standards did not meet criteria	Yes	7	450	1.56	Accuracy
VOC	Sediment	Matrices	Percent solids < 30 percent	No	1	450	0.22	Representativeness
VOC	Sediment	Matrices	Percent solids < 30 percent	Yes	4	450	0.89	Representativeness
VOC	Sediment	Surrogates	Surrogate recovery criteria were not met	No	5	450	1.11	Accuracy
VOC	Sediment	Surrogates	Surrogate recovery criteria were not met	Yes	2	450	0.44	Accuracy
VOC	Surface Water	Blanks	Method, preparation, or reagent blank contamination	No	22	1,056	2.08	Representativeness
VOC	Surface Water	Calibration	Continuing calibration verification criteria were not met	No	5	1,056	0.47	Accuracy
VOC	Surface Water	Calibration	Continuing calibration verification criteria were not met	Yes	1	1,056	0.09	Accuracy
VOC	Surface Water	Documentation Issues	Transcription error	No	14	1,056	1.33	N/A
VOC	Surface Water	Holding Times	Holding times were exceeded	No	12	1,056	1.14	Representativeness
VOC	Surface Water	Internal Standards	Internal standards did not meet criteria	No	46	1,056	4.36	Accuracy
Wet Chem	Sediment	Documentation Issues	Transcription error	No	1	22	4.55	N/A
Wet Chem	Sediment	Holding Times	Holding times were exceeded	Yes	1	22	4.55	Representativeness
Wet Chem	Sediment	Holding Times	Holding times were grossly exceeded	No	2	22	9.09	Representativeness
Wet Chem	Sediment	Matrices	Duplicate sample precision criteria were not met	Yes	1	22	4.55	Precision
Wet Chem	Sediment	Matrices	Percent solids < 30 percent	Yes	2	22	9.09	Representativeness
Wet Chem	Sediment	Matrices	Predigestion MS recovery was < 30 percent	Yes	5	22	22.73	Accuracy
Wet Chem	Surface Water	Blanks	Calibration verification blank contamination	No	1	444	0.23	Representativeness

Table A2.2.1
RC AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Wet Chem	Surface Water	Blanks	Negative bias indicated in the blanks	No	2	444	0.45	Representativeness
Wet Chem	Surface Water	Calibration	Calibration correlation coefficient did not meet requirements	Yes	5	444	1.13	Accuracy
Wet Chem	Surface Water	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	19	444	4.28	N/A
Wet Chem	Surface Water	Documentation Issues	Transcription error	No	5	444	1.13	N/A
Wet Chem	Surface Water	Documentation Issues	Transcription error	Yes	9	444	2.03	N/A
Wet Chem	Surface Water	Holding Times	Holding times were exceeded	No	5	444	1.13	Representativeness
Wet Chem	Surface Water	Holding Times	Holding times were exceeded	Yes	6	444	1.35	Representativeness
Wet Chem	Surface Water	Holding Times	Holding times were grossly exceeded	No	5	444	1.13	Representativeness
Wet Chem	Surface Water	Matrices	Predigestion MS recovery criteria were not met	Yes	6	444	1.35	Accuracy
Wet Chem	Surface Water	Matrices	Site samples were not used for sample matrix QC	Yes	1	444	0.23	Representativeness
Wet Chem	Surface Water	Other	IDL is older than 3 months from date of analysis	Yes	3	444	0.68	Accuracy
Wet Chem	Surface Water	Other	Lab results not verified due to unsubmitted data	Yes	1	444	0.23	Representativeness
Wet Chem	Surface Water	Sample Preparation	Samples were not properly preserved in the field	Yes	9	444	2.03	Representativeness

Table A2.2.2
MK AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Sediment	Blanks	Calibration verification blank contamination	No	8	348	2.30	Representativeness
Metal	Sediment	Blanks	Method, preparation, or reagent blank contamination	No	7	348	2.01	Representativeness
Metal	Sediment	Blanks	Method, preparation, or reagent blank contamination	Yes	2	348	0.57	Representativeness
Metal	Sediment	Blanks	Negative bias indicated in the blanks	No	2	348	0.57	Representativeness
Metal	Sediment	Blanks	Negative bias indicated in the blanks	Yes	4	348	1.15	Representativeness
Metal	Sediment	Calibration	Calibration correlation coefficient did not meet requirements	Yes	2	348	0.57	Accuracy
Metal	Sediment	Documentation Issues	Transcription error	Yes	3	348	0.86	N/A
Metal	Sediment	LCS	CRDL check sample recovery criteria were not met	No	1	348	0.29	Accuracy
Metal	Sediment	LCS	CRDL check sample recovery criteria were not met	Yes	3	348	0.86	Accuracy
Metal	Sediment	LCS	LCS recovery criteria were not met	No	12	348	3.45	Accuracy
Metal	Sediment	LCS	LCS recovery criteria were not met	Yes	33	348	9.48	Accuracy
Metal	Sediment	LCS	Low level check sample recovery criteria were not met	No	8	348	2.30	Accuracy
Metal	Sediment	LCS	Low level check sample recovery criteria were not met	Yes	6	348	1.72	Accuracy
Metal	Sediment	Matrices	Duplicate sample precision criteria were not met	Yes	4	348	1.15	Precision
Metal	Sediment	Matrices	LCS/LCSD precision criteria were not met	Yes	4	348	1.15	Precision

Table A2.2.2
MK AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Sediment	Matrices	Post-digestion MS did not meet control criteria	Yes	1	348	0.29	Accuracy
Metal	Sediment	Matrices	Predigestion MS recovery criteria were not met	No	9	348	2.59	Accuracy
Metal	Sediment	Matrices	Predigestion MS recovery criteria were not met	Yes	18	348	5.17	Accuracy
Metal	Sediment	Matrices	Serial dilution criteria were not met	Yes	13	348	3.74	Accuracy
Metal	Sediment	Other	See hard copy for further explanation	No	5	348	1.44	N/A
Metal	Sediment	Other	See hard copy for further explanation	Yes	20	348	5.75	N/A
Metal	Sediment	Sensitivity	IDL changed due to a significant figure discrepancy	No	1	348	0.29	Representativeness
Metal	Surface Water	Blanks	Calibration verification blank contamination	No	8	1,286	0.62	Representativeness
Metal	Surface Water	Blanks	Method, preparation, or reagent blank contamination	No	55	1,286	4.28	Representativeness
Metal	Surface Water	Blanks	Method, preparation, or reagent blank contamination	Yes	64	1,286	4.98	Representativeness
Metal	Surface Water	Blanks	Negative bias indicated in the blanks	No	18	1,286	1.40	Representativeness
Metal	Surface Water	Blanks	Negative bias indicated in the blanks	Yes	19	1,286	1.48	Representativeness
Metal	Surface Water	Calibration	Calibration correlation coefficient did not meet requirements	No	2	1,286	0.16	Accuracy
Metal	Surface Water	Calibration	Calibration correlation coefficient did not meet requirements	Yes	1	1,286	0.08	Accuracy
Metal	Surface Water	Calibration	Continuing calibration verification criteria were not met	No	2	1,286	0.16	Accuracy

Table A2.2.2
MK AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Surface Water	Calibration	Continuing calibration verification criteria were not met	Yes	8	1,286	0.62	Accuracy
Metal	Surface Water	Documentation Issues	Key data fields incorrect	No	5	1,286	0.39	N/A
Metal	Surface Water	Documentation Issues	Key data fields incorrect	Yes	20	1,286	1.56	N/A
Metal	Surface Water	Documentation Issues	Transcription error	No	13	1,286	1.01	N/A
Metal	Surface Water	Documentation Issues	Transcription error	Yes	40	1,286	3.11	N/A
Metal	Surface Water	Holding Times	Holding times were exceeded	No	12	1,286	0.93	Representativeness
Metal	Surface Water	Holding Times	Holding times were exceeded	Yes	2	1,286	0.16	Representativeness
Metal	Surface Water	LCS	CRDL check sample recovery criteria were not met	No	9	1,286	0.70	Accuracy
Metal	Surface Water	LCS	CRDL check sample recovery criteria were not met	Yes	4	1,286	0.31	Accuracy
Metal	Surface Water	LCS	LCS recovery criteria were not met	No	55	1,286	4.28	Accuracy
Metal	Surface Water	LCS	LCS recovery criteria were not met	Yes	119	1,286	9.25	Accuracy
Metal	Surface Water	LCS	Low level check sample recovery criteria were not met	No	8	1,286	0.62	Accuracy
Metal	Surface Water	LCS	Low level check sample recovery criteria were not met	Yes	2	1,286	0.16	Accuracy
Metal	Surface Water	Matrices	Duplicate sample precision criteria were not met	No	1	1,286	0.08	Precision
Metal	Surface Water	Matrices	Duplicate sample precision criteria were not met	Yes	12	1,286	0.93	Precision

Table A2.2.2
MK AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Surface Water	Matrices	Post-digestion MS did not meet control criteria	No	7	1,286	0.54	Accuracy
Metal	Surface Water	Matrices	Post-digestion MS did not meet control criteria	Yes	1	1,286	0.08	Accuracy
Metal	Surface Water	Matrices	Predigestion MS recovery criteria were not met	No	11	1,286	0.86	Accuracy
Metal	Surface Water	Matrices	Predigestion MS recovery criteria were not met	Yes	25	1,286	1.94	Accuracy
Metal	Surface Water	Matrices	Predigestion MS recovery was < 30 percent	Yes	2	1,286	0.16	Accuracy
Metal	Surface Water	Matrices	Serial dilution criteria were not met	Yes	22	1,286	1.71	Accuracy
Metal	Surface Water	Other	IDL is older than 3 months from date of analysis	No	27	1,286	2.10	Accuracy
Metal	Surface Water	Other	IDL is older than 3 months from date of analysis	Yes	31	1,286	2.41	Accuracy
Metal	Surface Water	Other	See hard copy for further explanation	No	17	1,286	1.32	N/A
Metal	Surface Water	Other	See hard copy for further explanation	Yes	30	1,286	2.33	N/A
Metal	Surface Water	Sensitivity	IDL changed due to a significant figure discrepancy	No	2	1,286	0.16	Representativeness
PCB	Sediment	Surrogates	Surrogate recovery criteria were not met	No	7	35	20.00	Accuracy
PCB	Surface Water	Surrogates	Surrogate recovery criteria were not met	No	7	14	50.00	Accuracy
Pesticide	Sediment	Surrogates	Surrogate recovery criteria were not met	No	20	106	18.87	Accuracy
Pesticide	Surface Water	Calibration	Continuing calibration verification criteria were not met	No	1	43	2.33	Accuracy

Table A2.2.2
MK AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Pesticide	Surface Water	Surrogates	Surrogate recovery criteria were not met	No	21	43	48.84	Accuracy
Radionuclide	Sediment	Blanks	Method, preparation, or reagent blank contamination	No	1	91	1.10	Representativeness
Radionuclide	Sediment	Blanks	Method, preparation, or reagent blank contamination	Yes	7	91	7.69	Representativeness
Radionuclide	Sediment	Calculation Errors	Calculation error	Yes	2	91	2.20	N/A
Radionuclide	Sediment	Calibration	Continuing calibration verification criteria were not met	Yes	4	91	4.40	Accuracy
Radionuclide	Sediment	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	12	91	13.19	Representativeness
Radionuclide	Sediment	Documentation Issues	Transcription error	No	1	91	1.10	N/A
Radionuclide	Sediment	Documentation Issues	Transcription error	Yes	16	91	17.58	N/A
Radionuclide	Sediment	Instrument Set-up	Detector efficiency did not meet requirements	Yes	4	91	4.40	Accuracy
Radionuclide	Sediment	LCS	LCS recovery > +/- 3 sigma	Yes	6	91	6.59	Accuracy
Radionuclide	Sediment	LCS	LCS relative percent error criteria not met	Yes	5	91	5.49	Accuracy
Radionuclide	Sediment	Matrices	Recovery criteria were not met	Yes	3	91	3.30	Accuracy
Radionuclide	Sediment	Matrices	Replicate analysis was not performed	No	1	91	1.10	Precision
Radionuclide	Sediment	Matrices	Replicate precision criteria were not met	Yes	9	91	9.89	Precision
Radionuclide	Sediment	Other	Lab results not verified due to unsubmitted data	Yes	1	91	1.10	Representativeness

Table A2.2.2
MK AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Sediment	Other	Sample exceeded efficiency curve weight limit	Yes	2	91	2.20	Accuracy
Radionuclide	Sediment	Other	See hard copy for further explanation	Yes	9	91	9.89	N/A
Radionuclide	Sediment	Sample Preparation	Improper aliquot size	Yes	1	91	1.10	Accuracy
Radionuclide	Sediment	Sensitivity	Incorrect reported activity or MDA	Yes	1	91	1.10	N/A
Radionuclide	Sediment	Sensitivity	MDA exceeded the RDL	Yes	2	91	2.20	Representativeness
Radionuclide	Sediment	Sensitivity	MDA was calculated by reviewer	Yes	29	91	31.87	N/A
Radionuclide	Sediment	Sensitivity	Results considered qualitative not quantitative	Yes	1	91	1.10	Accuracy
Radionuclide	Surface Water	Blanks	Method, preparation, or reagent blank contamination	No	1	128	0.78	Representativeness
Radionuclide	Surface Water	Blanks	Method, preparation, or reagent blank contamination	Yes	4	128	3.13	Representativeness
Radionuclide	Surface Water	Calibration	Calibration counting statistics did not meet criteria	No	1	128	0.78	Accuracy
Radionuclide	Surface Water	Calibration	Continuing calibration verification criteria were not met	No	3	128	2.34	Accuracy
Radionuclide	Surface Water	Calibration	Continuing calibration verification criteria were not met	Yes	21	128	16.41	Accuracy
Radionuclide	Surface Water	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	9	128	7.03	Representativeness
Radionuclide	Surface Water	Documentation Issues	Transcription error	No	12	128	9.38	N/A
Radionuclide	Surface Water	Documentation Issues	Transcription error	Yes	9	128	7.03	N/A

Table A2.2.2
MK AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Surface Water	Holding Times	Holding times were exceeded	No	5	128	3.91	Representativeness
Radionuclide	Surface Water	Holding Times	Holding times were exceeded	Yes	4	128	3.13	Representativeness
Radionuclide	Surface Water	LCS	Expected LCS value not submitted/verifiable	Yes	1	128	0.78	Representativeness
Radionuclide	Surface Water	LCS	LCS recovery > +/- 3 sigma	No	1	128	0.78	Accuracy
Radionuclide	Surface Water	LCS	LCS recovery > +/- 3 sigma	Yes	1	128	0.78	Accuracy
Radionuclide	Surface Water	LCS	LCS relative percent error criteria not met	Yes	3	128	2.34	Accuracy
Radionuclide	Surface Water	Matrices	Replicate analysis was not performed	Yes	2	128	1.56	Precision
Radionuclide	Surface Water	Matrices	Replicate precision criteria were not met	No	4	128	3.13	Precision
Radionuclide	Surface Water	Matrices	Replicate precision criteria were not met	Yes	3	128	2.34	Precision
Radionuclide	Surface Water	Other	Lab results not verified due to unsubmitted data	Yes	3	128	2.34	Representativeness
Radionuclide	Surface Water	Other	See hard copy for further explanation	No	6	128	4.69	N/A
Radionuclide	Surface Water	Other	See hard copy for further explanation	Yes	7	128	5.47	N/A
Radionuclide	Surface Water	Sensitivity	MDA exceeded the RDL	No	2	128	1.56	Representativeness
Radionuclide	Surface Water	Sensitivity	MDA was calculated by reviewer	Yes	19	128	14.84	N/A
SVOC	Sediment	Blanks	Method, preparation, or reagent blank contamination	No	1	405	0.25	Representativeness

Table A2.2.2
MK AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
SVOC	Sediment	Calibration	Continuing calibration verification criteria were not met	No	6	405	1.48	Accuracy
SVOC	Sediment	Internal Standards	Internal standards did not meet criteria	No	12	405	2.96	Accuracy
SVOC	Sediment	Internal Standards	Internal standards did not meet criteria	Yes	1	405	0.25	Accuracy
SVOC	Surface Water	Blanks	Method, preparation, or reagent blank contamination	No	1	102	0.98	Representativeness
VOC	Sediment	Blanks	Method, preparation, or reagent blank contamination	No	10	298	3.36	Representativeness
VOC	Sediment	Calibration	Continuing calibration verification criteria were not met	Yes	1	298	0.34	Accuracy
VOC	Sediment	Internal Standards	Internal standards did not meet criteria	No	8	298	2.68	Accuracy
VOC	Sediment	Internal Standards	Internal standards did not meet criteria	Yes	1	298	0.34	Accuracy
VOC	Sediment	Surrogates	Surrogate recovery criteria were not met	No	33	298	11.07	Accuracy
VOC	Sediment	Surrogates	Surrogate recovery criteria were not met	Yes	1	298	0.34	Accuracy
VOC	Surface Water	Blanks	Method, preparation, or reagent blank contamination	No	5	447	1.12	Representativeness
VOC	Surface Water	Calibration	Continuing calibration verification criteria were not met	No	2	447	0.45	Accuracy
VOC	Surface Water	Documentation Issues	Record added by the validator	No	34	447	7.61	N/A
Wet Chem	Sediment	Holding Times	Holding times were exceeded	Yes	1	12	8.33	Representativeness
Wet Chem	Sediment	Holding Times	Holding times were grossly exceeded	No	1	12	8.33	Representativeness

Table A2.2.2
MK AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Wet Chem	Sediment	Matrices	Predigestion MS recovery criteria were not met	No	1	12	8.33	Accuracy
Wet Chem	Sediment	Matrices	Predigestion MS recovery was < 30 percent	Yes	4	12	33.33	Accuracy
Wet Chem	Surface Water	Blanks	Method, preparation, or reagent blank contamination	No	1	131	0.76	Representativeness
Wet Chem	Surface Water	Calibration	Calibration correlation coefficient did not meet requirements	Yes	1	131	0.76	Accuracy
Wet Chem	Surface Water	Documentation Issues	Record added by the validator	No	4	131	3.05	N/A
Wet Chem	Surface Water	Documentation Issues	Record added by the validator	Yes	5	131	3.82	N/A
Wet Chem	Surface Water	Holding Times	Holding times were exceeded	No	2	131	1.53	Representativeness
Wet Chem	Surface Water	Holding Times	Holding times were exceeded	Yes	6	131	4.58	Representativeness
Wet Chem	Surface Water	LCS	LCS recovery criteria were not met	No	1	131	0.76	Accuracy
Wet Chem	Surface Water	Matrices	Duplicate sample precision criteria were not met	No	1	131	0.76	Precision
Wet Chem	Surface Water	Matrices	Duplicate sample precision criteria were not met	Yes	1	131	0.76	Precision
Wet Chem	Surface Water	Matrices	Predigestion MS recovery criteria were not met	No	1	131	0.76	Accuracy
Wet Chem	Surface Water	Other	IDL is older than 3 months from date of analysis	Yes	2	131	1.53	Accuracy

Table A2.2.3
SE AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Dioxins and Furans	Surface Water	Documentation Issues	Record added by the validator	No	1	1	100.00	N/A
Herbicide	Surface Water	Calibration	Continuing calibration verification criteria were not met	No	1	4	25.00	Accuracy
Metal	Sediment	Blanks	Calibration verification blank contamination	No	11	210	5.24	Representativeness
Metal	Sediment	LCS	Low level check sample recovery criteria were not met	No	10	210	4.76	Accuracy
Metal	Sediment	LCS	Low level check sample recovery criteria were not met	Yes	6	210	2.86	Accuracy
Metal	Sediment	Matrices	LCS/LCSD precision criteria were not met	Yes	4	210	1.90	Precision
Metal	Sediment	Matrices	Predigestion MS recovery criteria were not met	No	7	210	3.33	Accuracy
Metal	Sediment	Matrices	Predigestion MS recovery criteria were not met	Yes	13	210	6.19	Accuracy
Metal	Sediment	Matrices	Serial dilution criteria were not met	Yes	4	210	1.90	Accuracy
Metal	Sediment	Other	IDL is older than 3 months from date of analysis	No	14	210	6.67	Accuracy
Metal	Sediment	Other	IDL is older than 3 months from date of analysis	Yes	73	210	34.76	Accuracy
Metal	Surface Water	Blanks	Calibration verification blank contamination	No	8	469	1.71	Representativeness
Metal	Surface Water	Blanks	Method, preparation, or reagent blank contamination	No	5	469	1.07	Representativeness
Metal	Surface Water	Blanks	Method, preparation, or reagent blank contamination	Yes	37	469	7.89	Representativeness
Metal	Surface Water	Blanks	Negative bias indicated in the blanks	No	7	469	1.49	Representativeness
Metal	Surface Water	Blanks	Negative bias indicated in the blanks	Yes	2	469	0.43	Representativeness

Table A2.2.3
SE AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Surface Water	Calibration	Calibration correlation coefficient did not meet requirements	No	2	469	0.43	Accuracy
Metal	Surface Water	Documentation Issues	Key data fields incorrect	No	3	469	0.64	N/A
Metal	Surface Water	Documentation Issues	Key data fields incorrect	Yes	15	469	3.20	N/A
Metal	Surface Water	Documentation Issues	Transcription error	No	21	469	4.48	N/A
Metal	Surface Water	LCS	CRDL check sample recovery criteria were not met	Yes	1	469	0.21	Accuracy
Metal	Surface Water	LCS	LCS recovery criteria were not met	Yes	2	469	0.43	Accuracy
Metal	Surface Water	LCS	Low level check sample recovery criteria were not met	No	8	469	1.71	Accuracy
Metal	Surface Water	LCS	Low level check sample recovery criteria were not met	Yes	4	469	0.85	Accuracy
Metal	Surface Water	Matrices	Post-digestion MS did not meet control criteria	No	7	469	1.49	Accuracy
Metal	Surface Water	Matrices	Predigestion MS recovery criteria were not met	No	5	469	1.07	Accuracy
Metal	Surface Water	Matrices	Predigestion MS recovery criteria were not met	Yes	5	469	1.07	Accuracy
Metal	Surface Water	Matrices	Serial dilution criteria were not met	Yes	6	469	1.28	Accuracy
Metal	Surface Water	Other	IDL is older than 3 months from date of analysis	No	71	469	15.14	Accuracy
Metal	Surface Water	Other	IDL is older than 3 months from date of analysis	Yes	45	469	9.59	Accuracy
Pesticide	Surface Water	Calibration	Continuing calibration verification criteria were not met	No	4	30	13.33	Accuracy

Table A2.2.3
SE AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Pesticide	Surface Water	Documentation Issues	Transcription error	No	1	30	3.33	N/A
Radionuclide	Surface Water	Blanks	Blank recovery criteria were not met	No	1	83	1.20	Representativeness
Radionuclide	Surface Water	Blanks	Blank recovery criteria were not met	Yes	1	83	1.20	Representativeness
Radionuclide	Surface Water	Blanks	Method, preparation, or reagent blank contamination	Yes	4	83	4.82	Representativeness
Radionuclide	Surface Water	Calibration	Calibration counting statistics did not meet criteria	No	1	83	1.20	Accuracy
Radionuclide	Surface Water	Calibration	Continuing calibration verification criteria were not met	No	7	83	8.43	Accuracy
Radionuclide	Surface Water	Calibration	Continuing calibration verification criteria were not met	Yes	6	83	7.23	Accuracy
Radionuclide	Surface Water	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	11	83	13.25	Representativeness
Radionuclide	Surface Water	Documentation Issues	Transcription error	No	14	83	16.87	N/A
Radionuclide	Surface Water	Documentation Issues	Transcription error	Yes	9	83	10.84	N/A
Radionuclide	Surface Water	Holding Times	Holding times were exceeded	No	1	83	1.20	Representativeness
Radionuclide	Surface Water	Holding Times	Holding times were exceeded	Yes	2	83	2.41	Representativeness
Radionuclide	Surface Water	Holding Times	Holding times were grossly exceeded	No	1	83	1.20	Representativeness
Radionuclide	Surface Water	Instrument Set-up	Resolution criteria were not met	No	1	83	1.20	Representativeness
Radionuclide	Surface Water	LCS	Expected LCS value not submitted/verifiable	No	1	83	1.20	Representativeness

Table A2.2.3
SE AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Surface Water	LCS	Expected LCS value not submitted/verifiable	Yes	1	83	1.20	Representativeness
Radionuclide	Surface Water	LCS	LCS recovery > +/- 3 sigma	No	4	83	4.82	Accuracy
Radionuclide	Surface Water	LCS	LCS recovery > +/- 3 sigma	Yes	3	83	3.61	Accuracy
Radionuclide	Surface Water	LCS	LCS recovery criteria were not met	No	1	83	1.20	Accuracy
Radionuclide	Surface Water	LCS	LCS recovery criteria were not met	Yes	2	83	2.41	Accuracy
Radionuclide	Surface Water	LCS	LCS relative percent error criteria not met	No	2	83	2.41	Accuracy
Radionuclide	Surface Water	LCS	LCS relative percent error criteria not met	Yes	6	83	7.23	Accuracy
Radionuclide	Surface Water	Matrices	Replicate analysis was not performed	Yes	4	83	4.82	Precision
Radionuclide	Surface Water	Matrices	Replicate precision criteria were not met	No	3	83	3.61	Precision
Radionuclide	Surface Water	Matrices	Replicate precision criteria were not met	Yes	1	83	1.20	Precision
Radionuclide	Surface Water	Other	See hard copy for further explanation	No	2	83	2.41	N/A
Radionuclide	Surface Water	Other	See hard copy for further explanation	Yes	6	83	7.23	N/A
Radionuclide	Surface Water	Sensitivity	Incorrect reported activity or MDA	No	1	83	1.20	N/A
Radionuclide	Surface Water	Sensitivity	MDA exceeded the RDL	No	3	83	3.61	Representativeness
Radionuclide	Surface Water	Sensitivity	MDA exceeded the RDL	Yes	1	83	1.20	Representativeness

Table A2.2.3
SE AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Surface Water	Sensitivity	MDA was calculated by reviewer	Yes	25	83	30.12	N/A
SVOC	Surface Water	Documentation Issues	Transcription error	No	2	59	3.39	N/A
SVOC	Surface Water	Holding Times	Holding times were exceeded	No	1	59	1.69	Representativeness
SVOC	Surface Water	Other	See hard copy for further explanation	No	8	59	13.56	N/A
VOC	Surface Water	Blanks	Method, preparation, or reagent blank contamination	No	5	264	1.89	Representativeness
VOC	Surface Water	Calibration	Continuing calibration verification criteria were not met	No	8	264	3.03	Accuracy
VOC	Surface Water	Documentation Issues	Record added by the validator	No	31	264	11.74	N/A
VOC	Surface Water	Documentation Issues	Transcription error	No	55	264	20.83	N/A
VOC	Surface Water	Holding Times	Holding times were exceeded	No	29	264	10.98	Representativeness
VOC	Surface Water	Other	See hard copy for further explanation	No	1	264	0.38	N/A
Wet Chem	Sediment	Matrices	Predigestion MS recovery was < 30 percent	Yes	4	7	57.14	Accuracy
Wet Chem	Sediment	Other	IDL is older than 3 months from date of analysis	Yes	3	7	42.86	Accuracy
Wet Chem	Surface Water	Calibration	Calibration correlation coefficient did not meet requirements	Yes	1	63	1.59	Accuracy
Wet Chem	Surface Water	Documentation Issues	Record added by the validator	No	6	63	9.52	N/A
Wet Chem	Surface Water	Documentation Issues	Record added by the validator	Yes	3	63	4.76	N/A

Table A2.2.3
SE AEU - Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Wet Chem	Surface Water	Documentation Issues	Transcription error	No	1	63	1.59	N/A
Wet Chem	Surface Water	Documentation Issues	Transcription error	Yes	4	63	6.35	N/A
Wet Chem	Surface Water	Holding Times	Holding times were exceeded	No	3	63	4.76	Representativeness
Wet Chem	Surface Water	Holding Times	Holding times were grossly exceeded	No	2	63	3.17	Representativeness
Wet Chem	Surface Water	Holding Times	Holding times were grossly exceeded	Yes	1	63	1.59	Representativeness
Wet Chem	Surface Water	Matrices	Predigestion MS recovery criteria were not met	Yes	1	63	1.59	Accuracy
Wet Chem	Surface Water	Matrices	Predigestion MS recovery was < 30 percent	Yes	1	63	1.59	Accuracy
Wet Chem	Surface Water	Other	IDL is older than 3 months from date of analysis	Yes	4	63	6.35	Accuracy
Wet Chem	Surface Water	Other	Result obtained through dilution	Yes	1	63	1.59	N/A

Table A2.3.0
NN AEU - Summary of Data Estimated or Undetected Due to V&V Determinations

Analyte Group	Matrix	No. of CRA Data Records Qualified	Total No. of V&V CRA Records	Detect	Percent Qualified (%)
Dioxins and Furans	Surface Water	7	7	No	100.00
Herbicide	Sediment	1	16	No	6.25
Herbicide	Surface Water	3	16	No	18.75
Metal	Sediment	57	572	No	9.97
Metal	Sediment	118	572	Yes	20.63
Metal	Surface Water	232	2,135	No	10.87
Metal	Surface Water	245	2,135	Yes	11.48
PCB	Sediment	21	42	No	50.00
Pesticide	Sediment	61	134	No	45.52
Pesticide	Surface Water	2	103	No	1.94
Radionuclide	Sediment	1	158	No	0.63
Radionuclide	Sediment	2	158	Yes	1.27
Radionuclide	Surface Water	1	418	No	0.24
Radionuclide	Surface Water	2	418	Yes	0.48
SVOC	Sediment	75	937	No	8.00
SVOC	Sediment	3	937	Yes	0.32
SVOC	Surface Water	98	895	No	10.95
SVOC	Surface Water	7	895	Yes	0.78
VOC	Sediment	46	857	No	5.37
VOC	Sediment	10	857	Yes	1.17
VOC	Surface Water	234	1,582	No	14.79

Table A2.3.0
NN AEU - Summary of Data Estimated or Undetected Due to V&V Determinations

Analyte Group	Matrix	No. of CRA Data Records Qualified	Total No. of V&V CRA Records	Detect	Percent Qualified (%)
VOC	Surface Water	8	1,582	Yes	0.51
Wet Chem	Sediment	1	19	Yes	5.26
Wet Chem	Surface Water	7	183	No	3.83
Wet Chem	Surface Water	14	183	Yes	7.65
	Total	**1,256**	**8,109**		**15.49%**

Table A2.3.1
RC AEU - Summary of Data Estimated or Undetected Due to V&V Determinations

Analyte Group	Matrix	No. of CRA Data Records Qualified	Total No. of V&V CRA Records	Detect?	Percent Qualified (%)
Herbicide	Sediment	1	17	No	5.88
Metal	Sediment	89	608	No	14.64
Metal	Sediment	237	608	Yes	38.98
Metal	Surface Water	407	3,658	No	11.13
Metal	Surface Water	470	3,658	Yes	12.85
PCB	Sediment	14	84	No	16.67
Pesticide	Sediment	41	257	No	15.95
Radionuclide	Sediment	2	171	Yes	1.17
Radionuclide	Surface Water	2	301	Yes	0.66
SVOC	Sediment	92	1,094	No	8.41
SVOC	Surface Water	1	180	No	0.56
VOC	Sediment	100	450	No	22.22
VOC	Sediment	10	450	Yes	2.22
VOC	Surface Water	83	1,056	No	7.86
VOC	Surface Water	1	1,056	Yes	0.09
Wet Chem	Sediment	2	22	No	9.09
Wet Chem	Sediment	8	22	Yes	36.36
Wet Chem	Surface Water	13	444	No	2.93
Wet Chem	Surface Water	17	444	Yes	3.83
	Total	**1,590**	**8,429**		**18.86%**

Table A2.3.2
MK AEU - Summary of Data Estimated or Undetected Due to V&V Determinations

Analyte Group	Matrix	No. of CRA Data Records Qualified	Total No. of V&V CRA Records	Detect?	Percent Qualified (%)
Metal	Sediment	50	348	No	14.37
Metal	Sediment	96	348	Yes	27.59
Metal	Surface Water	200	1,286	No	15.55
Metal	Surface Water	284	1,286	Yes	22.08
PCB	Sediment	7	35	No	20.00
PCB	Surface Water	7	14	No	50.00
Pesticide	Sediment	20	106	No	18.87
Pesticide	Surface Water	22	43	No	51.16
Radionuclide	Surface Water	2	128	No	1.56
Radionuclide	Surface Water	1	128	Yes	0.78
SVOC	Sediment	18	405	No	4.44
VOC	Sediment	41	298	No	13.76
VOC	Sediment	1	298	Yes	0.34
VOC	Surface Water	7	447	No	1.57
Wet Chem	Sediment	2	12	No	16.67
Wet Chem	Sediment	5	12	Yes	41.67
Wet Chem	Surface Water	6	131	No	4.58
Wet Chem	Surface Water	8	131	Yes	6.11
	Total	**777**	**3,454**		**22.50%**

Table A2.3.3
SE AEU - Summary of Data Estimated or Undetected Due to V&V Determinations

Analyte Group	Matrix	No. of CRA Data Records Qualified	Total No. of V&V CRA Records	Detect?	Percent Qualified (%)
Herbicide	Surface Water	1	4	No	25.00
Metal	Sediment	25	210	No	11.90
Metal	Sediment	27	210	Yes	12.86
Metal	Surface Water	35	469	No	7.46
Metal	Surface Water	55	469	Yes	11.73
Pesticide	Surface Water	4	30	No	13.33
Radionuclide	Surface Water	4	83	No	4.82
Radionuclide	Surface Water	1	83	Yes	1.20
SVOC	Surface Water	9	59	No	15.25
VOC	Surface Water	40	264	No	15.15
Wet Chem	Sediment	4	7	Yes	57.14
Wet Chem	Surface Water	5	63	No	7.94
Wet Chem	Surface Water	4	63	Yes	6.35
	Total	**214**	**1,240**		**17.26%**

Table A2.4.0
NN AEU - Summary of Data Qualified as Undetected Due to Blank Contamination

Analyte Group	Matrix	No. of CRA Records Qualified as Undetected	Total No. of CRA Records with Detected Results[a]	Percent Qualified as Undetected
Metal	Sediment	10	440	2.27
Metal	Surface Water	42	1,115	3.77
	Total	**52**	**1,555**	**3.34%**

[a] As determined by the laboratory prior to V&V.

Table A2.4.1
RC AEU - Summary of Data Qualified as Undetected Due to Blank Contamination

Analyte Group	Matrix	No. of CRA Records Qualified as Undetected	Total No. of CRA Records with Detected Results[a]	Percent Qualified as Undetected
Metal	Sediment	9	453	1.99
Metal	Surface Water	94	1,956	4.81
Wet Chem	Surface Water	1	308	0.32
	Total	**104**	**2,717**	**3.83%**

[a] As determined by the laboratory prior to V&V.

Table A2.4.2
MK AEU - Summary of Data Qualified as Undetected Due to Blank Contamination

Analyte Group	Matrix	No. of CRA Records Qualified as Undetected	Total No. of CRA Records with Detected Results[a]	Percent Qualified as Undetected
Metal	Sediment	8	259	3.09
Metal	Surface Water	5	664	0.75
	Total	**13**	**923**	**1.41%**

[a] As determined by the laboratory prior to V&V.

Table A2.4.3
SE AEU - Summary of Data Qualified as Undetected Due to Blank Contamination

Analyte Group	Matrix	No. of CRA Records Qualified as Undetected	Total No. of CRA Records with Detected Results[a]	Percent Qualified as Undetected
Metal	Sediment	11	170	6.47
Metal	Surface Water	4	191	2.09
	Total	**15**	**361**	**4.16%**

[a] As determined by the laboratory prior to V&V.

Table A2.5.0
NN AEU - Summary of RPDs/DERs of Field Duplicate Analyte Pairs

Analyte Group	Matrix	No. of Duplicates Failing RPD/DER Criteria	Total No. of Duplicate Pairs	Percent Failure (%)	Field Duplicate Frequency (%)
Herbicide	Sediment	0	2	0.00	12.50
Herbicide	Surface Water	0	3	0.00	9.38
Metal	Sediment	1	56	1.79	9.76
Metal	Surface Water	5	412	1.21	16.70
PCB	Sediment	0	7	0.00	16.67
PCB	Surface Water	0	7	0.00	14.29
Pesticide	Sediment	0	22	0.00	16.42
Pesticide	Surface Water	0	23	0.00	13.86
Radionuclide	Surface Water	0	80	0.00	15.63
SVOC	Sediment	0	118	0.00	12.59
SVOC	Surface Water	0	178	0.00	13.09
VOC	Sediment	1	101	0.99	11.79
VOC	Surface Water	0	308	0.00	12.84
Wet Chem	Sediment	0	2	0.00	10.00
Wet Chem	Surface Water	1	56	1.79	25.23

Table A2.5.1
RC AEU - Summary of RPDs/DERs of Field Duplicate Analyte Pairs

Analyte Group	Matrix	No. of Duplicates Failing RPD/DER Criteria	Total No. of Duplicate Pairs	Percent Failure (%)	Field Duplicate Frequency (%)
Herbicide	Sediment	0	3	0.00	17.65
Metal	Sediment	0	89	0.00	14.64
Metal	Surface Water	2	312	0.64	7.38
Pesticide	Sediment	0	3	0.00	1.08
Radionuclide	Sediment	0	19	0.00	10.86
SVOC	Sediment	0	177	0.00	16.11
SVOC	Surface Water	0	3	0.00	1.47
VOC	Sediment	0	16	0.00	3.56
VOC	Surface Water	0	195	0.00	11.78
Wet Chem	Sediment	0	2	0.00	9.09
Wet Chem	Surface Water	1	47	2.13	9.40

Table A2.5.2
MK AEU - Summary of RPDs/DERs of Field Duplicate Analyte Pairs

Analyte Group	Matrix	No. of Duplicates Failing RPD/DER Criteria	Total No. of Duplicate Pairs	Percent Failure (%)	Field Duplicate Frequency (%)
Metal	Surface Water	0	56	0.00	3.07
PCB	Surface Water	0	14	0.00	66.67
Pesticide	Surface Water	0	42	0.00	65.63
Radionuclide	Surface Water	2	25	8.00	9.47
SVOC	Surface Water	0	44	0.00	43.14
VOC	Surface Water	0	37	0.00	8.28
Wet Chem	Surface Water	0	8	0.00	4.88

Table A2.5.3
SE AEU - Summary of RPDs/DERs of Field Duplicate Analyte Pairs

Analyte Group	Matrix	No. of Duplicates Failing RPD/DER Criteria	Total No. of Duplicate Pairs	Percent Failure (%)	Field Duplicate Frequency (%)
Metal	Sediment	12	30	40.00	14.29
Metal	Surface Water	0	88	0.00	16.18
Radionuclide	Surface Water	0	15	0.00	18.07
VOC	Surface Water	0	34	0.00	12.88
Wet Chem	Sediment	0	1	0.00	14.29
Wet Chem	Surface Water	0	10	0.00	13.70

Table A2.6.0
NN AEU - Summary of Data Rejected During V&V

Analyte Group	Matrix	Total No. of Rejected Records	Total No. of V&V Records	Percent Rejected (%)
Dioxins and Furans	Surface Water	0	7	0.00
Herbicide	Sediment	0	34	0.00
Herbicide	Surface Water	4	76	5.26
Metal	Sediment	4	738	0.54
Metal	Surface Water	187	5,138	3.64
PCB	Sediment	0	77	0.00
PCB	Surface Water	14	84	16.67
Pesticide	Sediment	4	247	1.62
Pesticide	Surface Water	46	315	14.60
Radionuclide	Sediment	64	295	21.69
Radionuclide	Surface Water	248	1,116	22.22
SVOC	Sediment	19	1,554	1.22
SVOC	Surface Water	278	4,702	5.91
VOC	Sediment	11	1,207	0.91
VOC	Surface Water	181	7,913	2.29
Wet Chem	Sediment	0	28	0.00
Wet Chem	Surface Water	1	480	0.21
	Total	**1,061**	**24,011**	**4.42%**

Table A2.6.1
RC AEU - Summary of Data Rejected During V&V

Analyte Group	Matrix	Total No. of Rejected Records	Total No. of V&V Records	Percent Rejected (%)
Herbicide	Sediment	6	30	20.00
Herbicide	Surface Water	0	4	0.00
Metal	Sediment	84	1,149	7.31
Metal	Surface Water	173	6,058	2.86
PCB	Sediment	42	196	21.43
PCB	Surface Water	0	42	0.00
Pesticide	Sediment	129	590	21.86
Pesticide	Surface Water	0	124	0.00
Radionuclide	Sediment	67	346	19.36
Radionuclide	Surface Water	370	1,055	35.07
SVOC	Sediment	258	1,773	14.55
SVOC	Surface Water	0	239	0.00
VOC	Sediment	250	1,034	24.18
VOC	Surface Water	29	1,638	1.77
Wet Chem	Sediment	2	31	6.45
Wet Chem	Surface Water	2	668	0.30
	Total	**1,412**	**14,977**	**9.43%**

Table A2.6.2
MK AEU - Summary of Data Rejected During V&V

Analyte Group	Matrix	Total No. of Rejected Records	Total No. of V&V Records	Percent Rejected (%)
Herbicide	Sediment	0	10	0.00
Herbicide	Surface Water	1	4	25.00
Metal	Sediment	5	462	1.08
Metal	Surface Water	70	2,403	2.91
PCB	Sediment	0	63	0.00
PCB	Surface Water	0	35	0.00
Pesticide	Sediment	1	190	0.53
Pesticide	Surface Water	0	105	0.00
Radionuclide	Sediment	24	153	15.69
Radionuclide	Surface Water	222	512	43.36
SVOC	Sediment	6	589	1.02
SVOC	Surface Water	16	234	6.84
VOC	Sediment	7	515	1.36
VOC	Surface Water	37	763	4.85
Wet Chem	Sediment	4	20	20.00
Wet Chem	Surface Water	5	255	1.96
	Total	**398**	**6,313**	**6.30%**

Table A2.6.3
SE AEU - Summary of Data Rejected During V&V

Analyte Group	Matrix	Total No. of Rejected Records	Total No. of V&V Records	Percent Rejected (%)
Dioxins and Furans	Surface Water	0	1	0.00
Herbicide	Surface Water	0	4	0.00
Metal	Sediment	0	210	0.00
Metal	Surface Water	14	552	2.54
PCB	Surface Water	0	7	0.00
Pesticide	Surface Water	0	30	0.00
Radionuclide	Sediment	0	45	0.00
Radionuclide	Surface Water	25	117	21.37
SVOC	Surface Water	1	78	1.28
VOC	Surface Water	6	332	1.81
Wet Chem	Sediment	0	7	0.00
Wet Chem	Surface Water	0	72	0.00
	Total	**46**	**1,455**	**3.16%**

Table A2.7.0
NN AEU - Summary of Data Quality Issues Identified by V&V

Analyte Group	Matrix	Categories Description	V&V Observation	Detect	Percent Observed	Percent Qualified U[a]	Percent Qualified J[b]	PARCC Parameter Affected	Impacts Risk Assessment Decisions
Dioxins and Furans	Surface Water	Calibration	Continuing calibration verification criteria were not met	No	100.00	0.00	100.00	Accuracy	No
Herbicide	Sediment	Holding Times	Holding times were exceeded	No	6.25	0.00	6.25	Representativeness	No
Herbicide	Sediment	Matrices	MS/MSD precision criteria were not met	No	62.50	0.00	0.00	Precision	No
Herbicide	Surface Water	Holding Times	Holding times were exceeded	No	12.50	0.00	12.50	Representativeness	No
Herbicide	Surface Water	Matrices	MS/MSD precision criteria were not met	No	12.50	0.00	0.00	Precision	No
Herbicide	Surface Water	Sample Preparation	Samples were not properly preserved in the field	No	6.25	0.00	0.00	Representativeness	No
Herbicide	Surface Water	Surrogates	Surrogate recovery criteria were not met	No	6.25	6.25	0.00	Accuracy	No
Metal	Sediment	Matrices	Predigestion MS recovery criteria were not met	Yes	9.27	0.00	9.27	Accuracy	No
Metal	Sediment	Other	IDL is older than 3 months from date of analysis	No	10.66	1.75	1.92	Accuracy	No
Metal	Sediment	Other	IDL is older than 3 months from date of analysis	Yes	40.03	0.00	9.97	Accuracy	No
PCB	Sediment	Surrogates	Surrogate recovery criteria were not met	No	50.00	0.00	50.00	Accuracy	No
Pesticide	Sediment	Matrices	MS/MSD precision criteria were not met	No	7.46	0.00	0.00	Precision	No
Pesticide	Sediment	Surrogates	Surrogate recovery criteria were not met	No	44.78	0.00	44.78	Accuracy	No
Radionuclide	Sediment	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	15.19	0.00	0.00	Representativeness	No
Radionuclide	Sediment	Instrument Set-up	Detector efficiency did not meet requirements	Yes	7.59	0.00	0.00	Accuracy	No
Radionuclide	Surface Water	Blanks	Method, preparation, or reagent blank contamination	Yes	6.46	0.00	0.00	Representativeness	No
Radionuclide	Surface Water	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	25.84	0.00	0.00	Representativeness	No

Table A2.7.0
NN AEU - Summary of Data Quality Issues Identified by V&V

Analyte Group	Matrix	Categories Description	V&V Observation	Detect	Percent Observed	Percent Qualified U[a]	Percent Qualified J[b]	PARCC Parameter Affected	Impacts Risk Assessment Decisions
Radionuclide	Surface Water	Holding Times	Holding times were exceeded	Yes	6.46	0.00	0.00	Representativeness	No
Radionuclide	Surface Water	Matrices	Replicate precision criteria were not met	Yes	6.94	0.00	0.48	Precision	No
SVOC	Sediment	Holding Times	Holding times were exceeded	No	6.19	0.00	6.19	Representativeness	No
SVOC	Sediment	Matrices	MS/MSD precision criteria were not met	No	56.67	1.07	0.00	Precision	No
SVOC	Surface Water	Holding Times	Holding times were exceeded	No	9.16	0.89	8.27	Representativeness	No
SVOC	Surface Water	Matrices	MS/MSD precision criteria were not met	No	12.40	0.34	0.00	Precision	No
SVOC	Surface Water	Sample Preparation	Samples were not properly preserved in the field	No	6.70	0.22	0.00	Representativeness	No
VOC	Surface Water	Holding Times	Holding times were exceeded	No	9.86	5.31	4.55	Representativeness	No
Wet Chem	Sediment	Other	IDL is older than 3 months from date of analysis	Yes	52.63	0.00	0.00	Accuracy	No

[a]Defined as validation qualifier codes containing "U"

[b]Defined as validation qualifier codes containing "J", except "UJ"

Table A2.7.1
RC AEU - Summary of Data Quality Issues Identified by V&V

Analyte Group	Matrix	Categories Description	V&V Observation	Detect	Percent Observed	Percent Qualified U[a]	Percent Qualified J[b]	PARCC Parameter Affected	Impacts Risk Assessment Decisions
Herbicide	Sediment	Surrogates	Surrogate recovery criteria were not met	No	5.88	0.00	5.88	Accuracy	No
Metal	Sediment	LCS	LCS recovery criteria were not met	No	6.25	0.00	6.25	Accuracy	No
Metal	Sediment	LCS	LCS recovery criteria were not met	Yes	21.55	0.00	21.55	Accuracy	No
Metal	Sediment	Matrices	Percent solids < 30 percent	Yes	7.89	0.00	7.89	Representativeness	No
PCB	Sediment	Surrogates	Surrogate recovery criteria were not met	No	16.67	0.00	16.67	Accuracy	No
Pesticide	Sediment	Surrogates	Surrogate recovery criteria were not met	No	15.95	0.00	15.95	Accuracy	No
Radionuclide	Sediment	Blanks	Method, preparation, or reagent blank contamination	Yes	12.87	0.00	1.17	Representativeness	No
Radionuclide	Sediment	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	17.54	0.00	0.00	Representativeness	No
Radionuclide	Surface Water	Blanks	Method, preparation, or reagent blank contamination	Yes	6.31	0.00	0.00	Representativeness	No
Radionuclide	Surface Water	Calibration	Continuing calibration verification criteria were not met	Yes	8.64	0.00	0.33	Accuracy	No
Radionuclide	Surface Water	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	19.27	0.00	0.00	Representativeness	No
Radionuclide	Surface Water	Matrices	Replicate precision criteria were not met	Yes	6.31	0.00	0.33	Precision	No
VOC	Sediment	Internal Standards	Internal standards did not meet criteria	No	18.89	0.00	18.89	Accuracy	No
Wet Chem	Sediment	Holding Times	Holding times were grossly exceeded	No	9.09	0.00	9.09	Representativeness	No
Wet Chem	Sediment	Matrices	Percent solids < 30 percent	Yes	9.09	0.00	9.09	Representativeness	No
Wet Chem	Sediment	Matrices	Predigestion MS recovery was < 30 percent	Yes	22.73	0.00	22.73	Accuracy	No

[a]Defined as validation qualifier codes containing "U"

[b]Defined as validation qualifier codes containing "J", except "UJ"

Table A2.7.2
MK AEU - Summary of Data Quality Issues Identified by V&V

Analyte Group	Matrix	Categories Description	V&V Observation	Detect	Percent Observed	Percent Qualified U[a]	Percent Qualified J[b]	PARCC Parameter Affected	Impacts Risk Assessment Decisions
Metal	Sediment	LCS	LCS recovery criteria were not met	Yes	9.48	0.00	9.48	Accuracy	No
Metal	Surface Water	LCS	LCS recovery criteria were not met	Yes	9.25	0.00	9.25	Accuracy	No
PCB	Sediment	Surrogates	Surrogate recovery criteria were not met	No	20.00	0.00	20.00	Accuracy	No
PCB	Surface Water	Surrogates	Surrogate recovery criteria were not met	No	50.00	0.00	50.00	Accuracy	No
Pesticide	Sediment	Surrogates	Surrogate recovery criteria were not met	No	18.87	0.00	18.87	Accuracy	No
Pesticide	Surface Water	Surrogates	Surrogate recovery criteria were not met	No	48.84	0.00	48.84	Accuracy	No
Radionuclide	Sediment	Blanks	Method, preparation, or reagent blank contamination	Yes	7.69	0.00	0.00	Representativeness	No
Radionuclide	Sediment	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	13.19	0.00	0.00	Representativeness	No
Radionuclide	Sediment	LCS	LCS recovery > +/- 3 sigma	Yes	6.59	0.00	0.00	Accuracy	No
Radionuclide	Sediment	Matrices	Replicate precision criteria were not met	Yes	9.89	0.00	0.00	Precision	No
Radionuclide	Surface Water	Calibration	Continuing calibration verification criteria were not met	Yes	16.41	0.00	0.78	Accuracy	No
Radionuclide	Surface Water	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	7.03	0.00	0.00	Representativeness	No
VOC	Sediment	Surrogates	Surrogate recovery criteria were not met	No	11.07	0.00	11.07	Accuracy	No
Wet Chem	Sediment	Holding Times	Holding times were exceeded	Yes	8.33	0.00	8.33	Representativeness	No
Wet Chem	Sediment	Holding Times	Holding times were grossly exceeded	No	8.33	0.00	8.33	Representativeness	No
Wet Chem	Sediment	Matrices	Predigestion MS recovery criteria were not met	No	8.33	0.00	8.33	Accuracy	No
Wet Chem	Sediment	Matrices	Predigestion MS recovery was < 30 percent	Yes	33.33	0.00	33.33	Accuracy	No

[a]Defined as validation qualifier codes containing "U"

[b]Defined as validation qualifier codes containing "J", except "UJ"

Table A2.7.3
SE AEU - Summary of Data Quality Issues Identified by V&V

Analyte Group	Matrix	Categories Description	V&V Observation	Detect	Percent Observed	Percent Qualified U[a]	Percent Qualified J[b]	PARCC Parameter Affected	Impacts Risk Assessment Decisions
Herbicide	Surface Water	Calibration	Continuing calibration verification criteria were not met	No	25.00	0.00	25.00	Accuracy	No
Metal	Sediment	Matrices	Predigestion MS recovery criteria were not met	Yes	6.19	0.00	6.19	Accuracy	No
Metal	Sediment	Other	IDL is older than 3 months from date of analysis	No	6.67	1.43	1.43	Accuracy	No
Metal	Sediment	Other	IDL is older than 3 months from date of analysis	Yes	34.76	0.00	4.29	Accuracy	No
Metal	Surface Water	Blanks	Method, preparation, or reagent blank contamination	Yes	7.89	0.00	7.89	Representativeness	No
Metal	Surface Water	Other	IDL is older than 3 months from date of analysis	No	15.14	0.85	2.35	Accuracy	No
Metal	Surface Water	Other	IDL is older than 3 months from date of analysis	Yes	9.59	0.00	1.07	Accuracy	No
Pesticide	Surface Water	Calibration	Continuing calibration verification criteria were not met	No	13.33	0.00	13.33	Accuracy	No
Radionuclide	Surface Water	Calibration	Continuing calibration verification criteria were not met	No	8.43	0.00	1.20	Accuracy	No
Radionuclide	Surface Water	Calibration	Continuing calibration verification criteria were not met	Yes	7.23	0.00	1.20	Accuracy	No
Radionuclide	Surface Water	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	13.25	0.00	0.00	Representativeness	No
Radionuclide	Surface Water	LCS	LCS relative percent error criteria not met	Yes	7.23	0.00	0.00	Accuracy	No
VOC	Surface Water	Holding Times	Holding times were exceeded	No	10.98	0.00	10.98	Representativeness	No
Wet Chem	Sediment	Matrices	Predigestion MS recovery was < 30 percent	Yes	57.14	0.00	57.14	Accuracy	No
Wet Chem	Sediment	Other	IDL is older than 3 months from date of analysis	Yes	42.86	0.00	0.00	Accuracy	No

Table A2.7.3
SE AEU - Summary of Data Quality Issues Identified by V&V

Analyte Group	Matrix	Categories Description	V&V Observation	Detect	Percent Observed	Percent Qualified U[a]	Percent Qualified J[b]	PARCC Parameter Affected	Impacts Risk Assessment Decisions
Wet Chem	Surface Water	Other	IDL is older than 3 months from date of analysis	Yes	6.35	0.00	0.00	Accuracy	No

[a]Defined as validation qualifier codes containing "U"

[b]Defined as validation qualifier codes containing "J", except "UJ"

COMPREHENSIVE RISK ASSESSMENT

NO NAME GULCH AQUATIC EXPOSURE UNIT, ROCK CREEK AQUATIC EXPOSURE UNIT, MCKAY DITCH AQUATIC EXPOSURE UNIT, SOUTHEAST AQUATIC EXPOSURE UNIT

VOLUME 15B1: ATTACHMENT 3

Statistical Analyses and Professional Judgment

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ACRONYMS AND ABBREVIATIONS

µg/kg	micrograms per kilogram
AET	apparent effect threshold
AEU	Aquatic Exposure Unit
AL	action level
bgs	below ground surface
BZ	Buffer Zone
CRA	Comprehensive Risk Assessment
DOE	U.S. Department of Energy
DQA	Data Quality Assessment
ECOI	ecological contaminant of interest
ECOPC	ecological contaminant of potential concern
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
EqP	equilibrium partitioning
ERA	Ecological Risk Assessment
ESL	ecological screening level
HEPA	high-efficiency particulate air
IA	Industrial Area
IHSS	Individual Hazardous Substance Site
LEL	lowest effect level
LOEC	lowest observed effect concentration
MDC	maximum detected concentration
mg/kg	milligrams per kilogram

mg/L	milligrams per liter
MK AEU	McKay Ditch Aquatic Exposure Unit
NAWQC	National Ambient Water Quality Criteria
NFA	No Further Action
NN AEU	No Name Gulch Aquatic Exposure Unit
NOAEL	no observed adverse effect level
NPDES	National Pollutant Discharge Elimination System
OU	Operable Unit
PAC	Potential Area of Concern
PCOC	potential contaminant of concern
PDSR	Pre-Demolition Survey Report
PEC	probable effect concentration
PEL	probable effect level
RC AEU	Rock Creek Aquatic Exposure Unit
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RLCR	Reconnaissance-Level Characterization Report
SE AEU	Southeast Aquatic Exposure Unit
SQG	sediment quality guideline
TNRCC	Texas Natural Resource Conservation Commission
UBC	under building contamination
UCL	upper confidence limit
UTL	upper tolerance limit
WRS	Wilcoxon Rank Sum

1.0 INTRODUCTION

This attachment presents the results for the statistical analyses and professional judgment evaluation used to select ecological contaminants of potential concern (ECOPCs) as part of the Ecological Risk Assessment (ERA) for four of the seven Aquatic Ecological Exposure Units (AEUs) at the Rocky Flats Environmental Technology Site (RFETS): No Name Gulch AEU (NN AEU), Rock Creek AEU (RC AEU), McKay Ditch AEU (MK AEU), and Southeast AEU (SE AEU). The remaining three AEUs are addressed in Appendix A, Volume 15B2 of the Resource Conservation and Recovery Act (RCRA) Facility Investigation-Remedial Investigation (RI)/Corrective Measures Study (CMS)-Feasibility Study (FS) Report (hereafter referred to as the RI/FS Report).

The methods used to perform the statistical analysis and to develop the professional judgment sections are described in Appendix A, Volume 2, Section 2.0 of the RI/FS Report and follow the Final Comprehensive Risk Assessment (CRA) Work Plan and Methodology, Revision 1 (DOE 2005).

2.0 RESULTS OF STATISTICAL COMPARISONS TO BACKGROUND FOR THE AQUATIC EXPOSURE UNITS

The results of the statistical background comparisons for inorganic and radionuclide and ecological contaminants of interest (ECOIs) in surface water (total and dissolved) and sediment samples (all depth intervals combined) collected from the AEUs are presented in this section. Surface water and sediment from NN AEU, RC AEU, MK AEU, and SE AEU included samples from locations considered part of the background data sets for RFETS. These background samples were included in the AEU data evaluated in the initial steps of the ECOPC identification. Background samples have been removed from the AEU data sets for the comparison of site sample concentrations to background concentrations that are presented in the following sections.

The field sample and background sample comparison box plots are presented in Figures A3.2.NN AEU.1 to A3.2.SE AEU.9.[1] The box plots display several reference points: 1) the line inside the box is the median; 2) the lower edge of the box is the 25th percentile; 3) the upper edge of the box is the 75th percentile; 4) the upper lines (called whiskers) are drawn to the greatest value that is less than or equal to 1.5 times the inter-quartile range (the interquartile range is between the 75th and 25th percentiles); 5) the lower whiskers are drawn to the lowest value that is greater than or equal to 1.5 times the inter-quartile range; and 6) solid circles are data points greater or less than the whiskers.

[1] Statistical background comparisons are not performed for analytes if: 1) the background concentrations are nondetections; 2) background data are unavailable; 3) the analyte has low detection frequency in the AEU or background data set (less than 20 percent); or 4) the analyte is an organic compound. Box plots are not provided for these analytes. However, these analytes are carried forward into the professional judgment evaluation.

ECOIs with concentrations in the AEUs that are statistically greater than background (or those where background comparisons were not performed) are carried through to the upper-bound exposure point concentration (EPC) –ecological screening level (ESL) comparison step of the ECOPC selection processes. ECOIs with concentrations that are not statistically greater than background are not identified as ECOPCs and are not evaluated further.

2.1 No Name Gulch (NN AEU)

2.1.1 Surface Water Total Concentrations

In surface water, total concentrations of aluminum, ammonia, barium, beryllium, iron, lithium, and vanadium have MDCs that exceed their ESL and detection frequencies greater than 5 percent. These ECOIs were carried forward into the statistical background comparison. Bis(2-ethylhexyl)phthalate, di-n-butylphthalate, phenanthrene, and phenol have MDCs that exceed their ESL and detection frequencies greater than 5 percent. The statistical comparison of the NN AEU surface water (total) data to background data is presented in Table A3.2.NN AEU.1, while summary statistics for background and NN AEU surface water (total) data are provided in Table A3.2.NN AEU.2.

The results of the statistical comparisons of the NN AEU surface water total concentrations data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Barium
- Lithium

Not Statistically Greater than Background at the 0.1 Significance Level

- Aluminum
- Iron
- Vanadium

Background Comparison Not Performed[1]

- Ammonia
- Beryllium
- Bis(2-ethylhexyl)phthalate
- Di-n-butylphthalate
- Phenanthrene
- Phenol

2.1.2 Surface Water Dissolved Concentrations

In surface water, dissolved concentrations of copper, lead, selenium, silver, and zinc have MDCs that exceed their ESL and detection frequencies greater than 5 percent. These ECOIs were carried forward into the statistical background comparison. Samples were not collected for analysis of dissolved organics. The statistical comparison of the NN AEU surface water (dissolved) data to background data is presented in Table A3.2.NN AEU.3, while summary statistics for background and NN AEU surface water (dissolved) data are provided in Table A3.2.NN AEU.4.

The results of the statistical comparisons of the NN AEU surface water dissolved concentrations data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Zinc

Not Statistically Greater than Background at the 0.1 Significance Level

- Copper

Background Comparison Not Performed[1]

- Lead
- Selenium
- Silver

2.1.3 Sediment

In sediment, aluminum, barium, iron, lead, and manganese have MDCs that exceed their ESL and detection frequencies greater than 5 percent. These ECOIs were carried forward into the statistical background comparison. Benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, chrysene, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene, and total PAHs have MDCs that exceed their ESL and detection frequencies greater than 5 percent. The statistical comparison of the NN AEU sediment data to background data is presented in Table A3.2.NN AEU.5, while summary statistics for background and NN AEU sediment data are provided in Table A3.2.NN AEU.6.

The results of the statistical comparisons of the NN AEU sediment concentrations data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Aluminum
- Barium
- Iron
- Lead

Not Statistically Greater than Background at the 0.1 Significance Level

- Manganese

Background Comparison Not Performed[1]

- Benzo(a)anthracene
- Benzo(a)pyrene

- Benzo(g,h,i)perylene
- Chrysene
- Indeno(1,2,3-cd)pyrene
- Phenanthrene
- Pyrene
- Total PAHs

2.2 Rock Creek (RC AEU)

2.2.1 Surface Water Total Concentrations

In surface water, total concentrations of aluminum, barium, beryllium, cyanide, iron, lithium, vanadium, and radium-226 have MDCs that exceeded their ESL and detection frequencies greater than 5 percent. Radium-226 and cyanide were detected only in the background data set and are not considered further in the ECOPC screening process.The other ECOIs were carried forward into the statistical background comparison. With respect to total organics in surface water, no analytes have MDCs greater than their ESLs and detection frequencies greater than 5 percent. The statistical comparison of the RC AEU surface water (total) data to background data is presented in Table A3.2.RC AEU.1, while summary statistics for background and RC AEU surface water (total) data are provided in Table A3.2.RC AEU.2.

The results of the statistical comparisons of the RC AEU surface water total concentrations data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Barium
- Lithium

Not Statistically Greater than Background at the 0.1 Significance Level

- Aluminum
- Iron
- Vanadium

Background Comparison Not Performed[1]

- Beryllium

2.2.2 Surface Water Dissolved Concentrations

In surface water, dissolved concentrations of cadmium, copper, and lead had MDCs that exceeded their ESL and detection frequencies greater than 5 percent. These ECOIs were carried forward into the statistical background comparison. Samples were not collected for analysis of dissolved organics. The statistical comparison of the RC AEU surface water (dissolved) data to background data is presented in Table A3.2.RC AEU.3, while summary statistics for background and RC AEU surface water (dissolved) data are provided in Table A3.2.RC AEU.4. Mercury exceeded the ESL but it was detected only in the background samples.

The results of the statistical comparisons of the RC AEU surface water dissolved concentrations data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- None

Not Statistically Greater than Background at the 0.1 Significance Level

- Copper

Background Comparison Not Performed[1]

- Cadmium
- Lead

2.2.3 Sediment

In sediment, 12 metals have MDCs that exceeded their ESL for the RC AEU. Eleven metals have detection frequencies greater than 5 percent (aluminum, arsenic, barium, cadmium, iron, lead, manganese, nickel, selenium, silver, and zinc). Antimony was only detected in a background sample collected within the RC AEU and was not detected in the site samples and therefore, antimony was not considered further in the ECOPC screening process. The other ECOIs were carried forward into the statistical background comparison. 2-Butanone, 4-methylphenol, pentachlorophenol, and total PAHs have MDCs that exceed their ESL and detection frequencies greater than 5 percent. 2-Butanone and 4-methylphenol were only detected within the background data sets, and are not considered further in the ECOPC screening process. The statistical comparison of the RC AEU sediment data to background data is presented in Table A3.2.RC AEU.5, while summary statistics for background and RC AEU sediment data are provided in Table A3.2.RC AEU.6.

The results of the statistical comparisons of the RC AEU sediment concentrations data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Aluminum
- Arsenic
- Barium
- Iron
- Lead
- Nickel
- Selenium
- Zinc

Not Statistically Greater than Background at the 0.1 Significance Level

- Manganese

Background Comparison Not Performed[1]

- Cadmium
- Silver
- Pentachlorophenol
- Total PAHs

2.3 McKay Ditch (MK AEU)

2.3.1 Surface Water Total Concentrations

In surface water, total concentrations of aluminum, iron, and vanadium have MDCs that exceed the ESL and detection frequencies greater than 5 percent. These ECOIs were carried forward into the statistical background comparison. With respect to total organics in surface water, no analytes have MDCs greater than their ESLs and detection frequencies greater than 5 percent. The statistical comparison of the MK AEU surface water (total) data to background data is presented in Table A.3.3.MK AEU.1, while summary statistics for background and MK AEU surface water (total) data are provided in Table A.3.3.MK AEU.2.

The results of the statistical comparisons of the MK AEU surface water total concentrations data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Aluminum
- Iron

Not Statistically Greater than Background at the 0.1 Significance Level

- Vanadium

Background Comparison Not Performed[1]

- None

2.3.2 Surface Water Dissolved Concentrations

In surface water, dissolved concentrations of cadmium, copper, lead, and zinc have MDCs that exceed their ESL and detection frequencies greater than 5 percent. These ECOIs were carried forward into the statistical background comparison. Samples were not collected for analysis of dissolved organics. The statistical comparison of the MK AEU surface water (dissolved) data to background data is presented in Table A.3.3.MK AEU.3, while summary statistics for background and MK AEU surface water (dissolved) data are provided in Table A.3.3.MK AEU.4.

The results of the statistical comparisons of the MK AEU surface water dissolved concentrations data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Zinc

Not Statistically Greater than Background at the 0.1 Significance Level

- Copper
- Lead

Background Comparison Not Performed[1]

- Cadmium

2.3.3 Sediment

In sediment, 10 inorganics have MDCs that exceeded their ESL and had detection frequencies greater than 5 percent (aluminum, antimony, chromium, copper, fluoride, iron, lead, nickel, selenium, and zinc). Antimony was only detected within the background data set, and is not considered further in the ECOPC screening process.The other inorganic ECOIs were carried forward into the statistical background comparison. 4-Methylphenol and total PAHs have MDCs that exceed ESLs and detection frequencies greater than 5 percent. 4-Methylphenol was only detected within the background data set, and is not considered further in the ECOPC screening process.The statistical comparison of the MK AEU sediment data to background data is presented in Table A.3.3.MK AEU.5, while summary statistics for background and MK AEU sediment data are provided in Table A.3.3.MK AEU.6.

The results of the statistical comparisons of the MK AEU sediment concentrations data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Aluminum
- Chromium
- Nickel

Not Statistically Greater than Background at the 0.1 Significance Level

- Copper
- Iron
- Lead
- Zinc

Background Comparison Not Performed[1]

- Fluoride
- Selenium

2.4 Southeast (SE AEU)

2.4.1 Surface Water Total Concentrations

In surface water, total concentrations of aluminum have an MDC that exceeds the ESL and a detection frequency greater than 5 percent. Aluminum was carried forward into the statistical background comparison. With respect to total organics in surface water, no analytes have MDCs greater than their ESLs and detection frequencies greater than 5 percent. The statistical comparison of the SE AEU surface water (total) data to background data is presented in Table A.3.3.SE AEU.1, while summary statistics for background and SE AEU surface water (total) data are provided in Table A.3.3.SE AEU.2.

The results of the statistical comparisons of the SE AEU surface water total concentrations data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- None

Not Statistically Greater than Background at the 0.1 Significance Level

- Aluminum

Background Comparison Not Performed[1]

- None

2.4.2 Surface Water Dissolved Concentrations

For surface water, dissolved silver has an MDC that exceeds the ESL and a detection frequency greater than 5 percent. Silver was carried forward into the statistical background comparison. Samples were not collected for analysis of dissolved organics. Astatistical comparison of the SE AEU silver surface water (dissolved) data to background data was not performed because there is only one sample for dissolved silver in the SE AEU (see Table A.3.3.SE AEU.3 and Table A.3.3.SE AEU.4.)

The results of the statistical comparison step for the SE AEU surface water dissolved concentrations data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- None

Not Statistically Greater than Background at the 0.1 Significance Level

- None

Background Comparison Not Performed[1]

- Silver

2.4.3 Sediment

In sediment, aluminum, barium, iron, and selenium have MDCs that exceed their ESL and detection frequencies greater than 5 percent. These ECOIs were carried forward into the statistical background comparison. The statistical comparison of the SE AEU sediment data to background data is presented in Table A.3.3.SE AEU.5, while summary statistics for background and SE AEU sediment data are provided in Table A.3.3.SE AEU.6.

The results of the statistical comparisons of the SE AEU sediment concentrations data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Aluminum
- Barium
- Iron

Not Statistically Greater than Background at the 0.1 Significance Level

- None

Background Comparison Not Performed[1]

- Selenium

3.0 UPPER-BOUND EXPOSURE POINT CONCENTRATION COMPARISON TO THRESHOLD ECOLOGICAL SCREENING LEVELS

ECOIs in surface water (total and dissolved) and sediment with concentrations that are statistically greater than background, or background comparisons were not performed, are evaluated further by comparing the EPCs to the ESLs. The EPCs are the 95 percent UCLs of the 90th percentile [upper tolerance limit (UTL)], or the MDC in the event that the UTL is greater than the MDC.

3.1 No Name Gulch (NN AEU)

3.1.1 Surface Water Total Concentrations

The UTLs for beryllium, lithium, selenium, and phenol are less than their ESLs. The UTLs for ammonia, barium, bis(2-ethylhexyl)phthalate, di-n-butylphthalate,phenanthrene, and phenol are greater than its ESL, and are evaluated further using professional judgment, as presented in Section 4.0.

3.1.2 Surface Water Dissolved Concentrations

Lead, selenium, silver, and zinc have UTLs that exceed their ESLs, and are evaluated further using professional judgment, as presented in Section 4.0.

3.1.3 Sediment

The UTLs for aluminum, barium, iron, lead, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, chrysene, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene, and total PAHs are greater than their ESL, and are evaluated further using professional judgment, as presented in Section 4.0.

3.2 Rock Creek (RC AEU)

3.2.1 Surface Water Total Concentrations

The UTLs for barium, beryllium, and lithium do not exceed their ESLs. Therefore, there are no ECOPCs in surface water (total) for the RC AEU.

3.2.2 Surface Water Dissolved Concentrations

The UTLs for cadmium and lead exceed their ESLs, and are evaluated further using professional judgment, as presented in Section 4.0.

3.2.3 Sediment

The UTLs for aluminum, arsenic, barium, cadmium, iron, lead, selenium, silver, zinc, and pentachlorophenol exceed their ESLs, and are evaluated further using professional judgment, as presented in Section 4.0. The UTL for nickel does not exceed the ESL, and is not considered further in the ECOPC screening process. Only one sediment sample in the RC AEU had a total PAH concentration that exceeded the ESL. In that sample, only benzo(a)pyrene was detected and the concentration was less than the analyte-specific ESL. Based on these results, total PAHs were not identified as an ECOPC for the RC AEU (see Section 2.3.1.1 of the main text of this volume).

3.3 McKay Ditch (MK AEU)

3.3.1 Surface Water Total Concentrations

The UTLs for aluminum and iron are greater than their ESLs, and are evaluated further using professional judgment, as presented in Section 4.0.

3.3.2 Surface Water Dissolved Concentrations

The UTLs for cadmium and zinc are greater than their ESLs, and are evaluated further using professional judgment, as presented in Section 4.0.

3.3.3 Sediment

The UTLs for aluminum, chromium, fluoride (MDC is used for UTL), nickel, and selenium are greater than their ESLs, and are evaluated further using professional judgment, as presented in Section 4.0.

3.4 Southeast (SE AEU)

3.4.1 Surface Water Total Concentrations

No analytes in SE AEU surface water (total) were statistically greater than background, therefore, the comparison of the UTL to the ESL was not performed. No ECOPCs were selected for SE AEU surface water (total concentrations).

3.4.2 Surface Water Dissolved Concentrations

Silver has a UTL that is greater than its ESL, and is evaluated further using professional judgment, as presented in Section 4.0.

3.4.3 Sediment

The UTLs for aluminum, barium, iron, and selenium are greater than their ESLs, and are evaluated further using professional judgment, as presented in Section 4.0.

4.0 PROFESSIONAL JUDGMENT

This section presents the results of the professional judgment step of the ECOPC selection processes for the ERA at the AEUs. The professional judgment evaluation takes into account the following lines of evidence: process knowledge, spatial trends, comparison to RFETS background and pattern recognition[2], and risk potential. Based on the weight of evidence evaluated in the professional judgment step, ECOIs are either included for further evaluation as ECOPCs in the risk characterization step, or excluded from further evaluation.

4.1 NN AEU

For the NNEU, the ECOPC selection process indicates many metals and organic analytes are ECOPCs in surface soil. Furthermore, the presence of organic analytes in environmental media is typically of anthropogenic origin. Therefore, considering runoff is a transport mechanism whereby surface water and sediment within the AEU may be impacted by ECOPCs or other ECOIs in EU surface soil, all ECOIs that pass through the EPC/ESL screen for surface water (total and dissolved concentrations) and sediment are considered ECOPCs, and are further evaluated in the risk characterizations for the NN AEU. The NN AEU ECOPCs are ammonia (un-ionized), total barium, dissolved lead, dissolved selenium, dissolved silver, dissolved zinc, bis(2-ethylhexylphthalate), di-n-butyl phthalate, phenantherene and phenol in surface water, and aluminum, barium, iron, lead, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)pyrene, chrysene, indeno(1,2,-cd)pyrene, phenanthrene, pyrene, and total PAHs in sediment.

4.2 RC AEU

The RC AEU has unique physical characteristics applicable to professional judgment for all ECOIs in the environmental media considered herein. The RC AEU is located in the northwestern portion of RFETS, well outside areas that were used historically for site operations. One Potential Area of Concern (PAC) exists within the RC AEU: Roadway Spraying (PAC 000-501). Roadways throughout the Buffer Zone (BZ) Operable Unit

[2] The pattern recognition evaluation includes the use of probability plots. If two or more distinct populations are evident in the probability plot, this suggests that one or more local releases may have occurred. Conversely, if only one distinct low-concentration population is defined, likely representing a background population, a local release may or may not have occurred. Similar to all statistical methods, the probability plot has limitations in cases where there is inadequate sampling and the magnitude of the release is relatively small. Thus, absence of two clear populations in the probability plots is consistent with, but not definitive proof of, the hypothesis that no releases have occurred. However, if a release has occurred within the sampled area and has been included in the samples, then the elemental concentrations associated with that release are either within the background concentration range or the entire sampled population represents a release, a highly unlikely probability.

(OU) were sprayed with waste oils for dust suppression. Reverse osmosis brine solutions and footing drain water were also applied. The sources of oil for roadway spraying in the buffer zone were one or both of the following: in October 1982, 120 liters of Number 2 diesel fuel from a tank spill on the northern side of Building 371 was used on roads; and in September 1983, 1,200 gallons of Mobil Number 634 gear lubrication oil from a Building 883 rolling mill lube system was used on Plant gravel roads. These oils are not expected to contain polychlorinated biphenyls (PCBs), but could contain polynuclear aromatic hydrocarbons (PAHs). Based on the available evidence, PAC 000-501 was proposed for No Further Action (NFA) in 1991. The NFA was approved in 2002 (EPA 2002) as documented in the 2002 HRR Update (DOE 2002). In general, NFAs were based on human health considerations. The purpose of the ERA portion of the CRA is to evaluate potential risks for ecological receptors following accelerated actions at RFETS. The Nickel Carbonyl Disposal area (IHSS 195), which was a drywell used for the decomposition of approximately 185 pounds of nickel carbonyl gas between March and September 1972, is also located in the area. A Risk Evaluation performed for the Final "No Further Action Justification" document determined that IHSS 195 presented no unacceptable risk to groundwater or human health and the environment. IHSS 195 was dispositioned in the August 1994 CAD/ROD for OU 16, Low Priority Sites. This PAC is not a likely source of contamination for the RC AEU.

The physical characteristics and principal surface features of the RC AEU are discussed in detail in Section 1.0 of this report.

The following sections outline the weight-of-evidence evaluation for the ECOIs exceeding background and ESLs in surface water and sediment and carried forward to the professional judgment step. These analytes are:

- Aluminum in sediment;
- Arsenic in sediment;
- Barium in sediment;
- Cadmium (dissolved) in surface water;
- Cadmium in sediment;
- Iron in sediment;
- Lead (dissolved) in surface water;
- Lead in sediment;
- Selenium in sediment;
- Silver in sediment;
- Zinc in sediment; and
- Pentachlorophenol in sediment.

As noted in the following subsections, all ECOIs for the RC AEU considered in the professional judgment step were eliminated as ECOPCs. This conclusion was reached through the consultative process with the regulatory agencies. Because there is uncertainty associated with eliminating the ECOIs as ECOPCs based on process knowledge, spatial trends, and pattern recognition, a risk potential section is included for each ECOI in the professional judgment process that presents information relating to the potential for adverse ecological effects due to the presence of the ECOIs in surface water and sediment in the RC AEU.

4.2.1 Aluminum in Sediment

<u>Summary of Process Knowledge</u>

As presented in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge for aluminum indicates a potential to have been released into the RFETS soil because of the aluminum metal inventory and presence of aluminum in waste generated during former operations. However, the localized documented source areas are remote from the RC AEU.

<u>Evaluation of Spatial Trends</u>

There are four exceedances of the sediment ESL (15,900 milligrams per kilogram [mg/kg]) at four separate locations in the Rock Creek AEU (see Figure A3.4.RC AEU.1). The ESL exceedances ranged from 17,000 to 19,500 mg/kg. The ESL was not exceeded in nine other sediment sample results at these four locations, showing that ESL exceedances are not consistent across the RC AEU. All sediment sample results for aluminum in the RC AEU are less than the maximum background concentration of 25,200 mg/kg. Although RC AEU concentrations for aluminum are statistically greater than background, the fact that the RC AEU MDC is within the range of background concentrations suggests that this shift in concentrations is small. There are no historical source areas upgradient or downgradient of these locations that would contribute to an elevated aluminum concentration. Therefore, aluminum concentrations in sediment are indicative of variations in naturally occurring aluminum.

<u>Pattern Recognition</u>

Aluminum was detected in 12 of the 12 sediment samples collected in the RC AEU (excluding background samples). Aluminum concentrations at the RC AEU range from 4,900 to 19,000 mg/kg, with a mean concentration of 12,092 mg/kg and a standard deviation of 3,754 mg/kg in the AEU-specific data set that excludes the background samples. Aluminum was detected in 55 of the 55 sediment samples collected in the background data set. Aluminum concentrations in background range from 811 to 25,200 mg/kg, with a mean concentration of 6,791 mg/kg and a standard deviation of 5,603 mg/kg (Table A3.2.RC AEU.6).

The probability plot for aluminum indicates one population approaching an asymptotic maximum upper background concentration of about 2 percent aluminum (Figure A3.4.RC AEU.21).

Risk Potential for Benthic Macroinvertebrates

The MDC for aluminum in RC AEU sediment (19,500 mg/kg) for the entire AEU data set including background samples exceeded the sediment ESL (15,900 mg/kg). While an MDC less than the ESL indicates that adverse effects associated with exposure to a given analyte are unlikely (EPA 1997), an MDC greater than or equal to the ESL does not indicate that risks are actually present, only that data are insufficient to exclude the potential for risk. Only four of 22 samples (22 of 22 detected) from RC AEU sediments exceeded the ESL for aluminum. These samples were collected between December 1991 and December 2004, and the low frequency of exceedances (18 percent) suggests that potential adverse effects are low. This ESL was based on the 85th percentile concentration in streams (TNRCC 1996; cited in MacDonald et al. 1999), which defined the sediment quality guideline (SQG) by the Texas Natural Resource Conservation Commission (TNRCC). The potential for adverse effects associated with this ESL is uncertain; however, the four samples that exceed the aluminum ESL did not exceed that level by a high magnitude (HQs less than 2). Therefore, despite the MDC exceeding the screening level ESL, it is unlikely that the concentrations of aluminum in sediment pose a potential for adverse effects to benthic organisms in RC AEU. Furthermore, none of the RC AEU aluminum concentrations in sediment are greater than the Lowest Observed Effect Concentration (LOEC) (58,000 mg/kg), and therefore, there is little potential for an adverse ecological effect.

Conclusion

The weight of evidence presented above shows that aluminum concentrations in sediment in the RC AEU are not likely a result of RFETS activities, but rather are representative of naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the AEU that would impact aluminum concentrations in sediment. It is unlikely that the concentrations of aluminum in sediment pose a potential for adverse effects to benthic organisms in the RC AEU. Aluminum is not considered an ECOPC in sediment for the RC AEU and is not further evaluated quantitatively.

4.2.2 Arsenic in Sediment

Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates arsenic is unlikely to be present in RC AEU media as a result of historical site-related activities.

Evaluation of Spatial Trends

There is one exceedance of the sediment ESL (9.79 mg/kg) at location BM69-000, which occurred on December 30, 2004 (see Figure A3.4.RC AEU.2). This ESL exceedance of 15.0 mg/kg was for a sample from 0 to 0.5 feet and is slightly above the arsenic background MDC in sediment of 8.7 mg/kg. At location BM69-000, there was another sediment sample taken from 0.5 to 1.25 feet, which had an arsenic concentration within the background range. Therefore, arsenic is not elevated at this location for all depths.

Pattern Recognition

Arsenic was detected in 12 of the 12 sediment samples collected in the RC AEU. Arsenic concentrations at the RC AEU range from 1.70 to 15.0 mg/kg, with a mean concentration of 4.85 mg/kg and a standard deviation of 3.82 mg/kg in the AEU-specific data set that excludes background samples. Arsenic was detected in 49 of the 55 sediment samples collected for the background data set. Arsenic concentrations in background range from 0.270 to 8.7 mg/kg, with a mean concentration of 2.43 mg/kg and a standard deviation of 1.92 mg/kg (Table A3.2.RC AEU.6).

The probability plot for arsenic indicates one population extending from about 1.70 to 6.0 mg/kg. In addition, there is an anomalously low sample (SD00246WC, 0.50 mg/kg) and two to three anomalously higher samples. The higher samples appear to be forming a trend extending from the background line that includes samples: SD00003JE, 7.7 mg/kg; 05F0276-003, 9.4 mg/kg; and 05F0276-001, 15 mg/kg arsenic. There are too few samples to estimate a line or the nature of these samples. However, correlations coefficients indicate a strong association with iron (r=0.91) for the 22 samples strongly suggesting that the arsenic is adsorbed to iron oxyhydroxide in the sediments. Given this relationship, the arsenic concentrations in the sediment increases directly with the iron concentration (Figure A3.4.RC AEU.22).

Risk Potential for Benthic Macroinvertebrates

The MDC for arsenic in RC AEU sediment (15 mg/kg) for the entire AEU data set including background samples exceeds the sediment ESL (9.79 mg/kg). While an MDC less than the ESL indicates that adverse effects associated with exposure to a given analyte are unlikely (EPA 1997), an MDC greater than or equal to the ESL does not indicate that risks are actually present, only that the potential for adverse effects cannot be excluded. Only one of 22 samples (21 of 22 detected) from RC AEU sediments exceeds the ESL (collected December 20, 2004). This low frequency of exceedances[3] (4.5 percent) suggests that potential adverse effects would not likely be widely distributed within the RC AEU. Further, the ESL was based on a consensus-based TEC (MacDonald et al. 2000a), at which the potential for adverse effects are first observed. Validation of this benchmark found that 74 percent of samples (n=150) below this concentration were accurately predicted to be non-toxic to benthic macroinvertebrates. The potential for adverse effects is uncertain at concentrations greater than this ESL, and below the consensus-based probable effects concentration (PEC) (33 mg/kg). It is, therefore, unlikely that arsenic, exceeding the screening level ESL in only one sample, poses an unacceptable risk to benthic populations that inhabit the RC AEU. Furthermore, none of the RC AEU arsenic concentrations in sediment are greater than the LOEC (33 mg/kg), and therefore, there is little potential for an adverse ecological effect.

Conclusion

The weight of evidence presented above shows that arsenic concentrations in sediment in the RC AEU are not likely a result of RFETS activities, but rather are representative of

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naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the AEU that would impact arsenic concentrations in sediment. It is unlikely that the concentrations of arsenic in sediment pose a potential for adverse effects to benthic organisms in the RC AEU. Arsenic is not considered an ECOPC in sediment for the RC AEU and is not further evaluated quantitatively.

4.2.3 Barium in Sediment

<u>Summary of Process Knowledge</u>

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates barium is unlikely to be present in RFETS media as a result of historical site-related activities.

<u>Evaluation of Spatial Trends</u>

There are five exceedances of the sediment ESL (189 mg/kg) at five separate locations in the Rock Creek AEU (see Figure A3.4.RC AEU.3). The ESL exceedances ranged from 209 to 360 mg/kg. However, the ESL was not exceeded for 12 sediment sample results at these five locations, showing that ESL exceedances are not consistent across the RC AEU. Two of the sediment sample results for barium (290 and 360 mg/kg) in the RC AEU are only slightly greater than the maximum background concentration of 260 mg/kg. Therefore, barium concentrations in sediment are indicative of variations in naturally occurring barium.

<u>Pattern Recognition</u>

Barium was detected in 12 of the 12 sediment samples collected in the RC AEU. Barium concentrations at the RC AEU range from 52.0 to 360 mg/kg, with a mean concentration of 165 mg/kg and a standard deviation of 86.6 mg/kg in the AEU-specific data set that excludes background samples. Barium was detected in 54 of the 54 sediment samples collected in the background data set. Barium concentrations in background range from 10.6 to 260 mg/kg, with a mean concentration of 78.9 mg/kg and a standard deviation of 58.8 mg/kg (Table A3.2.RC AEU.6).

The probability plot for barium indicates one population (Figure A3.4.RC AEU.23).

<u>Risk Potential for Benthic Macroinvertebrates</u>

The MDC for barium in RC AEU sediment (360 mg/kg) for the entire AEU data set including background samples exceeds the sediment ESL (189 mg/kg). While an MDC less than the ESL indicates that adverse effects associated with exposure to a given analyte are unlikely (EPA 1997), an MDC greater than or equal to the ESL does not indicate that risks are actually present, only that the potential for adverse effects cannot be excluded. Five of 22 samples (22 of 22 detected) from RC AEU sediments exceed the ESL for barium. These samples were collected between August 1991 and December 2004. This low frequency of exceedances (18 percent) suggests that potential adverse effects would not likely be widely distributed within the RC AEU. This ESL was based on the 85th percentile concentration in streams (TNRCC 1996; cited in MacDonald et al. 1999), which defined the SQG by TNRCC. The potential for adverse effects associated with this ESL is uncertain; however, the five samples that exceed the barium ESL did not exceed by a high magnitude (HQs less than 2). Therefore, it is unlikely that barium in sediment, exceeding the screening level ESL in relatively few samples, poses a potential for adverse effects to benthic organisms in RC AEU.

Conclusion

The weight of evidence presented above shows that barium concentrations in sediment in the RC AEU are not likely a result of RFETS activities, but rather are representative of variations in naturally occurring barium concentrations. There is no evidence of a release from potential sources inside or outside the AEU that would impact barium concentrations in sediment. Barium is not considered an ECOPC in sediment for the RC AEU and is not further evaluated quantitatively.

4.2.4 Cadmium in Surface Water and Sediment

Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates a potential for cadmium to have been released into RFETS media because of the metal inventory and presence of cadmium in waste generated during former operations. Spills of cadmium-contaminated wastes have also occurred at RFETS. However, the localized documented source areas are remote from the RC AEU.

Evaluation of Spatial Trends

Surface Water

The surface water ESL for dissolved cadmium (0.00025 milligrams per liter [mg/L]) was consistently exceeded at SW005, SW006, SW108, SW135, and SW137. These surface water sampling locations are spread out across the RC AEU (see Figure A3.4.RC AEU.4). All ESL exceedances are below 0.004 mg/L (see Figures A3.4.RC AEU.5 through A3.4.RC AEU.9), which is less than the maximum background concentration of 0.017 mg/L. Therefore, cadmium concentrations in surface water are indicative of variations in naturally occurring cadmium.

Sediment

There are two exceedances of the sediment ESL (0.99 mg/kg) at two separate locations in the RC AEU (see Figure A3.4.RC AEU.10). The ESL exceedances range from 1.10 to 1.30 mg/kg. All sediment sample results for cadmium in the RC AEU are less than or equal to the maximum background concentration of 1.3 mg/kg. Therefore, cadmium concentrations in sediment are indicative of variations in naturally occurring cadmium.

Pattern Recognition

Surface Water

Dissolved cadmium was detected in one of the 13 surface water samples collected in the RC AEU. The detected cadmium concentration at the RC AEU was 0.003 mg/L. The data set has a mean concentration of 0.002 mg/L and a standard deviation of 0.0005 mg/L using one-half the reported value for nondetects (in the AEU-specific data set that excludes background samples). Cadmium was detected in 10 of the 136 surface water samples collected in the background data set. Cadmium concentrations in background range from 0.001 to 0.017 mg/L, with a mean concentration of 0.002 mg/L and a standard deviation of 0.001 mg/L (Table A3.2.RC AEU.4). The concentrations of dissolved cadmium at SW005, SW006, SW108, SW135, and SW137 are extremely low relative to the MDC in background (Figures A3.4 RC AEU.5 through A3.4 RC AEU 9. The probability plot for cadmium indicates one population extending from non-detected concentrations to about 0.003 mg/l and the three samples with higher cadmium concentrations(Figure A3.4.RC AEU.24)..These three samples include: SW01288WC, 0.0030 mg/l; SW01855WC, 0.0032 mg/l; and SW01852WC with 0.0034 mg/l cadmium.

Sediment

Cadmium was detected in five of the 12 sediment samples collected in the RC AEU. Cadmium concentrations at the RC AEU range from 0.210 to 1.10 mg/kg, with a mean concentration of 0.580 mg/kg and a standard deviation of 0.231 mg/kg in the AEU-specific data set that excludes background samples. Cadmium was detected in five of the 48 sediment samples collected in the background data set. Cadmium concentrations in background range from 0.410 to 1.30 mg/kg, with a mean concentration of 0.525 mg/kg and a standard deviation of 0.345 mg/kg (Table A3.2.RC AEU.6).

The probability plot for cadmium indicates one population (Figure A3.4.RC AEU.26).

Risk Potential for Benthic Macroinvertebrates

Surface Water

The MDC for cadmium in RC AEU surface water (0.003 mg/L) for the entire AEU data set including background samples exceeds the ESL (0.00025 mg/L). While an MDC less than the ESL indicates that adverse effects associated with exposure to a given analyte are unlikely (EPA 1997), an MDC greater than or equal to the ESL does not indicate that risks are actually present, only that the potential for adverse effects cannot be excluded. A total of six of 42 samples (six of 42 detected) from RC AEU surface waters exceed the ESL for cadmium. These samples were collected between July 1991 and March 1992. The low frequency of exceedance in detected concentrations (14 percent) suggests that potential adverse effects may not be widely distributed.

Sediment

The MDC for cadmium in RC AEU sediment (1.3 mg/kg) for the entire AEU data set including background samples exceeds the sediment ESL (0.99 mg/kg). While an MDC less than the ESL indicates that adverse effects associated with exposure to a given analyte are unlikely (EPA 1997), an MDC greater than or equal to the ESL does not indicate that risks are actually present, only that the potential for adverse effects cannot be excluded. Only two of 19 samples (seven of 19 detected) from RC AEU sediments exceed the ESL for cadmium. These samples were collected during August 1991 and December 2004. This low frequency of exceedances (11 percent) suggests that potential adverse effects would not likely be widely distributed within the RC AEU. Further, the ESL was based on a consensus-based TEC (MacDonald et al. 2000a), where the potential for adverse effects are first observed. Validation of this benchmark found that 80.4 percent of samples (n=347) below this concentration were accurately predicted to be non-toxic to benthic macroinvertebrates. The potential for adverse effects is uncertain at concentrations greater than this ESL, and below the consensus-based PEC (4.98 mg/kg). It is, therefore, unlikely that cadmium in sediment, exceeding the screening level ESL by a low magnitude (HQs<2) in relatively few samples, poses a potential for adverse effects to benthic organisms in the RC AEU.

Conclusion

The weight of evidence presented above shows that cadmium concentrations in surface water and sediment in the RC AEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the AEU that would impact cadmium concentrations in surface water and sediment. It is unlikely that cadmium in surface water and sediment exceeding the screening level ESLs by a low magnitude in relatively few samples poses a potential for adverse effects to aquatic and benthic organisms in RC AEU. Cadmium is not considered an ECOPC in surface water and sediment for the RC AEU and is not further evaluated quantitatively.

4.2.5 Iron in Sediment

Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates iron is unlikely to be present in RFETS media as a result of historical site-related activities.

Evaluation of Spatial Trends

There is one exceedance of the background MDC (31,400 mg/kg) at location BM69-000, which occurred on December 30, 2004 (see Figure A3.4.RC AEU.11). The background MDC is above the sediment ESL of 20,000 mg/kg. The one background MDC exceedance of 39,000 mg/kg was sampled from 0 to 0.5 feet and is slightly above the background MDC. At location BM69-000, there was another sediment sample taken from 0.5 to 1.25 feet that has an iron concentration within the background range. Therefore, iron is not elevated at this location for all depths.

Pattern Recognition

Iron was detected in 12 of the 12 sediment samples collected in the RC AEU. Iron concentrations at the RC AEU range from 7,800 to 39,000 mg/kg, with a mean concentration of 16,633 mg/kg and a standard deviation of 9,246 mg/kg in the AEU-specific data set that excludes background samples. Iron was detected in 55 of the 55 sediment samples collected in the background data set. Iron concentrations in background range from 1,040 to 31,400 mg/kg, with a mean concentration of 9,740 mg/kg and a standard deviation of 6,739 mg/kg (Table A3.2.RC AEU.6).

The probability plot for iron indicates one population extending from about 7,220 to 39,000 mg/kg. In addition, there is one anomalously low sample (SD00246WC, 2,520 mg/kg). The anomalously low sample is the same sample that was anomalously low for arsenic supporting the association between the arsenic and iron oxyhydroxide in the sediments (Figure A3.4.RC AEU.26).

Risk Potential for Benthic Macroinvertebrates

The MDC for iron in RC AEU sediment (39,000 mg/kg) for the entire AEU-specific data set including background samples exceeds the sediment ESL (20,000 mg/kg). While an MDC less than the ESL indicates that adverse effects associated with exposure to a given analyte are unlikely (EPA 1997), an MDC greater than or equal to the ESL does not indicate that risks are actually present, only that the potential for adverse effects cannot be excluded. Three of 22 samples (22 of 22 detected) from RC AEU sediments exceed the ESL for iron. These samples were collected between March 1993 and December 2004. This low frequency of exceedances (14 percent) suggests that potential adverse effects would not likely be widely distributed within the RC AEU. The ESL was based on a lowest effect level (LEL) (NYSDEC 1994; cited in MacDonald et al. 1999). The potential for adverse effects associated with this ESL is low because the three samples greater than the iron ESL did not exceed that level by a high magnitude (HQs less than 2). Therefore, a low exceedance frequency and low magnitude of exceedance suggest the potential for adverse effects to benthic macroinvertebrate receptors from iron in sediments at the RC AEU is unlikely. Furthermore, none of the RC AEU iron concentrations in sediment are greater than the LOEC (280,000 mg/kg), and therefore, there is little potential for an adverse ecological effect.

Conclusion

The weight of evidence presented above shows that iron concentrations in sediment in the RC AEU are not likely a result of RFETS activities, but rather are representative of variations of naturally occurring iron. There is no evidence of a release from potential sources inside or outside the AEU that would impact iron concentrations in sediment. It is unlikely that the concentrations of iron in sediment pose a potential for adverse effects to benthic organisms in the RC AEU. Iron is not considered an ECOPC in sediment for the RC AEU and is not further evaluated quantitatively.

4.2.6 Lead in Surface Water and Sediment

Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates a potential for lead to have been released into RFETS media because of the metal inventory and presence of lead in waste generated during former operations. Spills of lead contaminated wastes have also occurred at RFETS. However, the localized documented source areas are remote from the RC AEU.

Evaluation of Spatial Trends

Surface Water

The surface water ESL for dissolved lead (0.003 mg/L) was exceeded at sampling locations SW005, SW006 and SW134 (see Figure A3.4.RC AEU.13 through

Figure A3.4.RC AEU.15) for the complete RC AEU data set (including background). The surface water ESL was exceeded only three times out of 41 samples. The infrequent number of ESL exceedances at a limited number of sampling locations shows that ESL exceedances are not consistent across the RC AEU. All ESL exceedances are less than the maximum background concentration of 0.013 mg/L. Therefore, dissolved lead concentrations in surface water are indicative of variations in naturally occurring lead.

Sediment

There are four exceedances of the sediment ESL (35.8 mg/kg) at three separate locations in the RC AEU (see Figure A3.4.RC AEU.16). The ESL exceedances range from 37.0 to 79.1 mg/kg. The ESL was not exceeded though for five sediment sample results at these three locations, showing that ESL exceedances are not consistent across the RC AEU. One of the sediment sample results for lead (79.1 mg/kg) in the RC AEU is slightly greater than the maximum background concentration of 68.8 mg/kg. Therefore, lead concentrations in sediment are indicative of variations in natural occurring lead.

Pattern Recognition

Surface Water

Dissolved lead was detected in one of the 13 surface water samples collected in the RC AEU. The detected lead concentration at the RC AEU is 0.002 mg/L. The data set has a mean concentration of 0.0006 mg/L and a standard deviation of 0.0003 mg/L for the AEU-specific data set that excludes background samples (using one-half the reported value for nondetects). Lead was detected in 32 of the 133 surface water samples collected in the background data set. Lead concentrations in background range from 0.0001 to 0.013 mg/L, with a mean concentration of 0.002 mg/L and a standard deviation of 0.003 mg/L (Table A3.2.RC AEU.4).

The probability plot for lead indicates one population extending from non-detected concentrations to about 0.0032 mg/l. In addition, there are two anomalously high samples. The two anomalously high samples include: SW01932WC, 0.0088 mg/l; and SW02022WC with 0.0121 mg/l lead (Figure A3.4.RC AEU.27).

Sediment

Lead was detected in 12 of the 12 sediment samples collected in the RC AEU. Lead concentrations at the RC AEU range from 6.60 to 79.1 mg/kg, with a mean concentration of 25.7 mg/kg and a standard deviation of 19.6 mg/kg in the AEU-specific data set that excludes background samples. Lead was detected in 55 of the 55 sediment samples collected in the background data set. Lead concentrations in background range from 2.60 to 68.8 mg/kg, with a mean concentration of 13.3 mg/kg and a standard deviation of 12.4 mg/kg (Table A3.2.RC AEU.6).

The probability plot for lead indicates one population (Figure A3.4.RC AEU.28).

Risk Potential for Benthic Macroinvertebrates

Surface Water

The MDC for dissolved lead in RC AEU surface water (0.0121 mg/L)) for the entire AEU data set including background samples is greater than the ESL (0.0025 mg/L). While an MDC less than the ESL indicates that adverse effects associated with exposure to a given analyte are unlikely (EPA 1997), an MDC greater than or equal to the ESL does not indicate that risks are actually present, only that the potential for adverse effects cannot be excluded. A total of three detected concentrations from RC AEU surface waters exceeded the ESL for lead. These samples were collected between July 1991 and October 1994. This low frequency of exceedances (7 percent) suggests that potential adverse effects from lead in surface water at RC AEU are unlikely.

Sediment

The MDC for lead in RC AEU sediment (79.1 mg/kg) for the entire AEU data set including background samples exceeds the sediment ESL (35.8 mg/kg). While an MDC less than the ESL indicates that adverse effects associated with exposure to a given analyte are unlikely (EPA 1997), an MDC greater than or equal to the ESL does not indicate that risks are actually present, only that the potential for adverse effects cannot be excluded. Only four of 22 samples (22 of 22 detected) from RC AEU sediments exceeded the ESL (collected June 1992 through January 1995). This low frequency of exceedances (18 percent) suggests that potential adverse effects would not likely be widely distributed within the RC AEU. Further, the ESL was based on a consensus-based TEC (MacDonald et al. 2000a), where the potential for adverse effects are first observed. Validation of this benchmark found that 81.6 percent of samples (n=347) below this concentration were accurately predicted to be non-toxic to benthic macroinvertebrates. The potential for adverse effects associated with this ESL is low because the four samples greater than the iron ESL did not exceed that level by a high magnitude (maximum HQ of 2.2). The potential for adverse effects is uncertain at concentrations greater than this ESL, and below the consensus-based PEC (128 mg/kg). Therefore, the potential for adverse effects to benthic macroinvertebrate receptors from lead in sediment at the RC AEU is unlikely.

Conclusion

The weight of evidence presented above shows that lead concentrations in sediment and surface water in the RC AEU are not likely a result of RFETS activities, but rather are representative of naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the AEU that would impact lead concentrations in sediment and surface water. The low frequency of exceedances of the site-specific ESL (and low magnitude) suggests the potential for adverse effects to aquatic organisms from lead (dissolved) in surface water is unlikely. The potential for adverse effects to benthic macroinvertebrate receptors from lead in sediment at the RC AEU is also unlikely. Lead is not considered an ECOPC in sediment and surface water for the RC AEU and is not further evaluated quantitatively.

4.2.7 Selenium in Sediment

Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates selenium is unlikely to be present in RFETS media as a result of historical site-related activities.

Evaluation of Spatial Trends

There are four exceedances of the sediment ESL (0.95 mg/kg) at one location in the RC AEU (see Figure A3.4.RC AEU.17) but this location is designated as a background sample. The ESL exceedances ranged from 1.50 to 3.20 mg/kg. The ESL was not exceeded for two sediment sample results at this location, showing that ESL exceedances are not consistent at this location and ESL exceedances are not seen across the RC AEU. All sediment sample results for selenium in the RC AEU are less than or equal to the maximum background concentration of 3.2 mg/kg. Although RC AEU concentrations for selenium are statistically greater than background, the fact that the RC AEU MDC is within the range of background concentrations suggests that this shift in concentrations is small.

Pattern Recognition

Selenium was detected in three of the 12 sediment samples collected in the RC AEU. Selenium concentrations at the RC AEU range from 0.380 to 0.810 mg/kg, with a mean concentration of 0.534 mg/kg and a standard deviation of 0.361 mg/kg in the AEU-specific data set that excludes background samples. Selenium was detected in 15 of the 54 sediment samples collected in the background data set. Selenium concentrations in background range from 0.100 to 3.20 mg/kg, with a mean concentration of 0.458 mg/kg and a standard deviation of 0.634 mg/kg (Table A3.2.RC AEU.6).

The probability plot for selenium indicates one population (Figure A3.4.RC AEU.29).

Risk Potential for Benthic Macroinvertebrates

The MDC for selenium in RC AEU sediment (0.81 mg/kg) is less than the sediment ESL (0.95 mg/kg) when the background data is excluded from the EU-specific data set. While an MDC less than the ESL indicates that adverse effects associated with exposure to a given analyte are unlikely (EPA 1997), an MDC greater than or equal to the ESL does not indicate that risks are actually present, only that the potential for adverse effects cannot be excluded. Four samples from the complete RC AEU data set (including the background samples collected within the RC AEU) exceed the sediment ESL. These samples were collected between March 1992 and March 1993. This low frequency of exceedances (18 percent) suggests that potential adverse effects would not likely be widely distributed within the RC AEU. This ESL was based on the 85th percentile concentration in streams (TNRCC 1996; cited in MacDonald et al. 1999), which defined the SQG by TNRCC. The potential for adverse effects associated with this ESL is low, because the four samples that exceed the selenium ESL did not exceed by a high magnitude (HQs less than 3.5). Therefore, it is unlikely that the selenium in sediment poses a potential for adverse effects to benthic organisms in the RC AEU.

Conclusion

The weight of evidence presented above shows that selenium concentrations in sediment in the RC AEU are not likely a result of RFETS activities, but rather are representative of naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the AEU that would impact selenium concentrations in sediment. It is unlikely that the selenium in sediment poses a potential for adverse effects to benthic organisms in the RC AEU. Selenium is not considered an ECOPC in sediment for the RC AEU and is not further evaluated quantitatively.

4.2.8 Silver in Sediment

Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates a potential for silver to have been released into RFETS media because of the metal inventory and presence of silver in waste generated during former operations. However, the localized documented source areas are remote from RC AEU.

Evaluation of Spatial Trends

There are five exceedances of the sediment ESL (1 mg/kg) at four separate locations in the RC AEU (see Figure A3.4.RC AEU.18). The ESL exceedances ranged from 1.20 to 3.40 mg/kg. Silver was not detected in nine sediment sample results at these four locations. However, some detection limits exceeded the ESLs. All sediment sample results for silver in the RC AEU are less than or equal to the maximum background concentration of 3.4 mg/kg. Therefore, silver concentrations in sediment are indicative of variations in naturally occurring silver.

Pattern Recognition

Silver was detected in two of the 12 sediment samples collected in the RC AEU from locations that are not designated as background samples. Silver concentrations at the RC AEU range from 1.20 to 1.30 mg/kg, with a mean concentration of 0.628 mg/kg and a standard deviation of 0.483 mg/kg in the AEU-specific data set that excludes background samples. Silver was detected in three of the 48 sediment samples collected in the background data set. Silver concentrations in background range from 1.40 to 3.40 mg/kg, with a mean concentration of 0.737 mg/kg and a standard deviation of 0.654 mg/kg (Table A3.2.RC AEU.6).

The probability plot for silver indicates one population (Figure A3.4.RC AEU.30).

Risk Potential for Benthic Macroinvertebrates

The MDC for silver in RC AEU sediment (3.4 mg/kg) for the entire AEU data set including background samples exceeds the sediment ESL (1 mg/kg). While an MDC less than the ESL indicates that adverse effects associated with exposure to a given analyte are unlikely (EPA 1997), an MDC greater than or equal to the ESL does not indicate that risks are actually present, only that the potential for adverse effects cannot be excluded. Four of 19 samples from RC AEU sediments exceed the ESL for silver. These samples were collected between December 1991 and March 1992. This moderate frequency of exceedances (21 percent) suggests that potential adverse effects within the RC AEU cannot be excluded. The ESL was based on a LEL (NYSDEC 1994; cited in MacDonald et al. 1999). The potential for adverse effects associated with this ESL is low because the four detected samples that exceed the silver ESL did not exceed that level by a high magnitude (HQs less than 3.5). It is, therefore, unlikely that the silver in sediment poses a potential for adverse effects to benthic organisms in the RC AEU. Furthermore, none of the RC AEU silver concentrations in sediment are greater than the LOEC (1.6 mg/kg), and therefore, there is little potential for an adverse ecological effect.

Conclusion

The weight of evidence presented above shows that silver concentrations in sediment in the RC AEU are not likely a result of RFETS activities, but rather are representative of naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the AEU that would impact silver concentrations in sediment. It is unlikely that the concentrations of silver in sediment pose a potential for adverse effects to benthic organisms in the RC AEU. Silver is not considered an ECOPC in sediment for the RC AEU and is not further evaluated quantitatively.

4.2.9 Zinc in Sediment

Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, zinc was used in moderate quantities at RFETS. However, zinc was not identified or discussed in building process information, and has not been found associated with UBC areas.

Evaluation of Spatial Trends

There are three exceedances of the sediment ESL (121 mg/kg) at one location in the RC AEU (see Figure A3.4.RC AEU.19), but this is a location designated as a background sample. The ESL exceedances ranged from 331 to 720 mg/kg for the complete data set. The ESL was not exceeded for one sediment sample result at this location, showing that ESL exceedances are not consistent at this location in the RC AEU. All sediment sample results for zinc in the RC AEU are less than or equal to the maximum background concentration of 720 mg/kg.

Pattern Recognition

Zinc was detected in 12 of the 12 sediment samples collected in the RC AEU. Zinc concentrations at the RC AEU range from 29.0 to 95.0 mg/kg, with a mean concentration of 62.4 mg/kg and a standard deviation of 18.5 mg/kg in the AEU-specific data set that excludes background samples. Zinc was detected in 54 of the 55 sediment samples collected in the background data set. Zinc concentrations in background range from 6.50

to 720 mg/kg, with a mean concentration of 72.2 mg/kg and a standard deviation of 129 mg/kg (Table A3.2.RC AEU.6).

The probability plot for zinc indicates one population extending from about 11.3 to 95 mg/kg. In addition, there are three anomalously high samples. The three anomalously high samples include: SD00294WC, 331 mg/kg; SD00318WC, 639 mg/kg; and SD00007JE with 720 mg/kg zinc. This sample with the highest anomalous zinc concentration is one of the three anomalously high arsenic concentrations but the other two are apparently not related (Figure A3.4.RC AEU.31)

<u>Risk Potential for Benthic Macroinvertebrates</u>

The MDC for zinc in RC AEU sediment (95 mg/kg) excluding the background data set is less than sediment ESL (121 mg/kg). While an MDC less than the ESL indicates that adverse effects associated with exposure to a given analyte are unlikely (EPA 1997), an MDC greater than or equal to the ESL does not indicate that risks are actually present, only that the potential for adverse effects cannot be excluded. Only three samples from RC AEU sediments exceed the ESL for zinc, and they are in the background data set. These samples were collected during August 1991 and March 1993. This low frequency of exceedances (14 percent) suggests that potential adverse effects would not likely be widely distributed within the RC AEU. Further, the ESL was based on a consensus-based TEC (MacDonald et al. 2000a), where the potential for adverse effects are first observed. Validation of this benchmark found that 81.6 percent of samples (n=347) below this concentration were accurately predicted to be non-toxic to benthic macroinvertebrates. The potential for adverse effects is uncertain at concentrations greater than this ESL, and below the consensus-based PEC (459 mg/kg). Only two samples (9 percent) exceed this PEC. It is, therefore, unlikely that zinc in sediment, exceeding the screening level ESL by a low magnitude (HQs<6) in relatively few samples, poses a potential for adverse effects to benthic organisms in the RC AEU.

<u>Conclusion</u>

The weight of evidence presented above shows that zinc concentrations in sediment in the RC AEU are not likely a result of RFETS activities, but rather are representative of naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the EU that would impact zinc concentrations in sediment. Only two samples (10 percent) exceed the PEC. It is, therefore, unlikely that zinc in sediment, exceeding the screening level ESL by a low magnitude in relatively few samples collected over 10 years ago, poses a potential for adverse effects to benthic organisms in the RC AEU. Zinc is not considered an ECOPC in sediment for the RC AEU and is not further evaluated quantitatively.

4.2.10 Pentachlorophenol in Sediment

<u>Summary of Process Knowledge</u>

There are no documented historical source areas present in the RC AEU and no documented operations or activities that occurred in RC AEU involving the use of pentachlorophenol (DOE 1992). Therefore, the potential for pentachlorophenol to be present in the RC AEU is low.

Evaluation of Spatial Trends

There is only one detection of pentachlorophenol of 1,500 mg/kg at location BM69-000, which occurred on December 30, 2004 (see Figure A3.4.RC AEU.20). The one detection is above the sediment ESL of 255 mg/kg. This single detection was sampled from 0 to 0.5 feet and is above the sediment ESL. In addition, detection limits for the other samples were greater than the ESLs.

Pattern Recognition

Not applicable because background comparisons (and box plots) were not performed for organic compounds.

Risk Potential for Benthic Macroinvertebrates

The MDC for pentachlorophenol in RC AEU sediment (1,500 mg/kg) exceeds the sediment ESL (255 mg/kg). While an MDC less than the ESL indicates that adverse effects associated with exposure to a given analyte are unlikely (EPA 1997), an MDC greater than or equal to the ESL does not indicate that risks are actually present, only that the potential for adverse effects cannot be excluded. One detected concentration (one of 19 samples) of pentachlorophenol from RC AEU sediments exceeds the ESL. This sample was collected in December 2004. The pentachlorophenol ESL for sediment was based on an equilibrium partitioning (EqP)-based equation using the chronic ESL for surface water, and an estimate of 1 percent organic carbon (EPA 1997). There is uncertainty added to the potential for risk evaluation when extrapolating screening benchmarks using this method. However, it is the best option when alternative screening benchmarks are unavailable. Nevertheless, a low HQ (5.9) suggest the potential for adverse effects to benthic macroinvertebrate receptors from pentachlorophenol in sediments at the RC AEU is low.

Conclusion

The weight of evidence presented above shows that pentachlorophenol concentrations in sediment in the RC AEU are not likely a result of RFETS activities. There is no evidence of a release from potential sources inside or outside the AEU that would impact pentachlorophenol concentrations in sediment. In addition, a low HQ suggests the potential for adverse effects to benthic macroinvertebrate receptors from pentachlorophenol in sediments at the RC AEU is low. Pentachlorophenol is not considered an ECOPC in sediment for the RC AEU and is not further evaluated quantitatively.

4.3 MK AEU

For the Inter-Drainage EU (IDEU), which comprises most of the MK AEU, the ECOPC selection process indicates some metals are ECOPCs in surface soil. Considering runoff is a transport mechanism whereby surface water and sediment within the AEU may be impacted by ECOPCs or other ECOIs in EU surface soil, all ECOIs that pass through the EPC/ESL screen for surface water (total and dissolved concentrations) and sediment are considered ECOPCs, and are further evaluated in the risk characterizations for the MK AEU. The MK AEU ECOPCs are total aluminum, dissolved cadmium, total iron, and dissolved zinc in surface water, and aluminum, chromium, fluoride, nickel, and selenium in sediment.

4.4 SE AEU

The SE AEU has unique physical characteristics applicable to professional judgment for all ECOIs in the environmental media considered herein. The SE AEU is located in the southern portion of RFETS, well outside areas that were used historically for site operations. The SE AEU does not receive runoff from the IA. Only one PAC exists within the SE AEU: Roadway Spraying (PAC 000-501). Roadways throughout the BZ OU were sprayed with waste oils for dust suppression, and reverse osmosis brine solutions and footing drain water were also applied. Based on the available evidence, PAC 000-501 was proposed for NFA in 1991. The NFA was approved in 2002 (EPA 2002) as documented in the 2002 HRR Update (DOE 2002). Only a small segment of PAC 000-501 exists in the SE AEU and, based on the above findings, it is not a likely source of contamination for the SE AEU.

The physical characteristics and principal surface features of the SE AEU are discussed in detail in Section 1.0 of this report.

The following sections outline the weight-of-evidence evaluation for the ECOIs exceeding background and ESLs in sediment and are being carried forward to the professional judgment step. These analytes are:

- Aluminum in sediment
- Barium in sediment
- Iron in sediment
- Selenium in sediment
- Silver in surface water

As noted in the following subsections, all ECOIs for the SE AEU considered in the professional judgment step were eliminated as ECOPCs. This conclusion was reached through the consultative process with the regulatory agencies. Because there is uncertainty associated with eliminating the ECOIs as ECOPCs based on process knowledge, spatial trends, and pattern recognition, a risk potential section is included for each ECOI in the professional judgment process that presents information relating to the potential for adverse ecological effects due to the presence of the ECOIs in surface water and sediment in the SE AEU.

4.4.1 Aluminum in Sediment

Summary of Process Knowledge

As presented in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge for aluminum indicates a potential to have been released into the RFETS soil because of the aluminum metal inventory and presence of aluminum in waste generated during former operations. However, the localized documented source areas are remote from the SE AEU.

Evaluation of Spatial Trends

Three of five locations have sediment concentrations that exceed the ESL. These locations included CC16-000, D013-000, and DY05-000 (see Figure A3.4.SE AEU.1). However, only one location, DY05-000, exceeded the background MDC. Samples were collected at CC16-000 on December 29, 2004, while sample collection at D013-000 and DY05-000 occurred on January 10, 2005. Two samples were collected at CC16-000 at depths from 0 to 0.5 and 0.5 to 1.75 feet with respective concentrations of 16,000 and 20,000 mg/kg, both of which exceed the ESL. The sample from 0 to 0.5 feet was just above the ESL (15,900 mg/kg). Neither of these concentrations, however, exceeds the background MDC (25,200 mg/kg), suggesting that detected concentrations are within background levels. Two sediment samples were also collected at D013-000 from 0 to 0.4 and from 0.5 to1 foot below ground surface (bgs) with respective concentrations of 18,000 and 25,000 mg/kg. Both concentrations exceed the ESL, although neither exceeds the background MDC. Only one sample was collected at DY05-000. This sample was collected from 0 to 0.5 feet bgs and has a detected concentration of 26,000 mg/kg, which exceeds both the ESL and the background MDC, although this concentration was just above the background MDC (25,200 mg/kg). Based on this data, it is likely that aluminum concentrations are within background levels.

Pattern Recognition

Aluminum was detected in seven of the seven sediment samples collected in the SE AEU. Aluminum concentrations at the SE AEU range from 7,600 to 26,000 mg/kg, with a mean concentration of 18,229 mg/kg and a standard deviation of 6,295 mg/kg in the AEU-specific data set that excludes background samples. Aluminum was detected in 55 of the 55 sediment samples collected in the background data set. Aluminum concentrations in background range from 811 to 25,200 mg/kg, with a mean concentration of 6,791 mg/kg and a standard deviation of 5,603 mg/kg (Table A3.2.SE AEU.6).

The probability plot for aluminum indicates one population (Figure A3.4.SE AEU.8)

Risk Potential for Benthic Macroinvertebrates

The MDC for aluminum in SE AEU sediment (26,000 mg/kg) for the entire AEU data set including background samples exceeds the sediment ESL (15,900 mg/kg). While an MDC less than the ESL indicates that adverse effects associated with exposure to a given analyte are unlikely (EPA 1997), an MDC greater than or equal to the ESL does not indicate that risks are actually present, only that data are insufficient to exclude the potential for risk. Five of seven samples (seven of seven detected) from SE AEU sediments exceeded the ESL for aluminum. These samples were collected between December 2005 and January 2005, and the high frequency of exceedances (71 percent) suggests that potential adverse effects cannot be excluded for sediment in the SE AEU. This ESL was based on the 85th percentile concentration in streams (TNRCC 1996; cited in MacDonald et al. 1999), which defined the SQG by TNRCC. The potential for adverse effects associated with this ESL is uncertain; however, the five samples from three locations that exceed the aluminum ESL did not exceed by a high magnitude (HQs less than 2). Therefore, despite the MDC exceeding the screening level ESL, it is unlikely that the concentrations of aluminum in SE AEU sediment pose a potential for adverse effects to benthic organisms in the SE AEU. Furthermore, none of the SE AEU aluminum concentrations in sediment are greater than the LOEC (58,000 mg/kg), and therefore, there is little potential for an adverse ecological effect.

Conclusion

The weight of evidence presented above shows that aluminum concentrations in sediment in the SE AEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the EU that would impact aluminum concentrations in sediment. It is unlikely that the concentrations of aluminum in sediment pose a potential for adverse effects to benthic organisms in the SE AEU. Aluminum is not considered an ECOPC in sediment for the SE AEU and is not further evaluated quantitatively.

4.4.2 Barium in Sediment

Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates barium is unlikely to be present in RFETS media as a result of historical site-related activities.

Evaluation of Spatial Trends

Two of five locations have sediment concentrations that exceed the ESL. These locations included D013-000 and DY05-000 (see Figure A3.4.SE AEU.2). However, none of the locations exceeded the background MDC. Samples were collected at D013-000 and DY05-000 on January 10, 2005. Two sediment samples were collected at D013-000 from 0 to 0.4 and from 0.5 to 1 foot bgs with respective concentrations of 130 mg/kg and 190 mg/kg. Only one sample just exceeds the ESL, while neither sample exceeds the background MDC. Only one sample was collected at DY05-000. This sample has a detected concentration of 240 mg/kg, which exceeds the ESL but not the background MDC. Although SE AEU concentrations for barium are statistically greater than background, the fact that the RC AEU MDC is within the range of background concentrations suggests that this shift in concentrations is small. Based on these concentrations, it is likely that barium concentrations are within background levels.

Pattern Recognition

Barium was detected in seven of the seven sediment samples collected in the SE AEU. Barium concentrations at the SE AEU range from 77 to 240 mg/kg, with a mean concentration of 158 mg/kg and a standard deviation of 51.6 mg/kg in the AEU-specific data set that excludes background samples. Barium was detected in 54 of the 54 sediment samples collected in the background data set. Barium concentrations in background range from 10.6 to 260 mg/kg, with a mean concentration of 78.9 mg/kg and a standard deviation of 58.8 mg/kg (Table A3.2.SE AEU.6).

The probability plot for barium indicates one population (Figure A3.4.SE AEU.9).

Risk Potential for Benthic Macroinvertebrates

The MDC for barium in SE AEU sediment (240 mg/kg) for the entire AEU data set including background samples exceeds the ESL (189 mg/kg). While an MDC less than the ESL indicates that adverse effects associated with exposure to a given analyte are unlikely (EPA 1997), an MDC greater than or equal to the ESL does not indicate that risks are actually present, only that the potential for adverse effects cannot be excluded. Only two samples (seven of seven detected) from SE AEU sediments exceed the ESL for barium. These samples were collected in January 2005. This moderate frequency of exceedances (29 percent) suggests the potential for adverse effects cannot be excluded. The barium ESL was based on the 85th percentile concentration in streams (TNRCC 1996; cited in MacDonald et al. 1999), which defined the SQG for TNRCC. The potential for adverse effects associated with this ESL is uncertain; however, the samples greater than the barium ESL did not exceed by a high magnitude (HQs less than 2). Toxicity from barium in sediment is not well documented and there are no other applicable screening criteria available for this metal. It is, therefore, unlikely that barium in sediment, exceeding the screening level ESL by a low magnitude, poses a potential for adverse effects to benthic organisms in the SE AEU. Furthermore, none of the SE AEU barium concentrations in sediment are greater than the LOEC (287 mg/kg), and therefore, there is little potential for an adverse ecological effect.

Conclusion

The weight of evidence presented above shows that barium concentrations in sediment in the SE AEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the AEU that would impact barium concentrations in sediment. It is unlikely that the concentrations of barium in sediment pose a potential for adverse effects to benthic organisms in the SE AEU. Barium is not considered an ECOPC in sediment for the SE AEU and is not further evaluated quantitatively.

4.4.3 Iron in Sediment

Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates iron is unlikely to be present in RFETS media as a result of historical site-related activities.

Evaluation of Spatial Trends

Two of five locations had sediment concentrations that exceed the ESL. These locations included D013-000 and DY05-000 (see Figure A3.4.SE AEU.3). However, only one location, D013-000, exceeds the background MDC. Samples were collected at D013-000 and DY05-000 in January 2005. Two samples were collected at DO13-000 at depths from 0 to 0.4 feet and from 0.5 to 1 foot bgs with respective concentrations of 34,000 and 23,000 mg/kg, both of which exceeded the ESL. The 0.5-to-1-foot sample, however, was within the background MDC (31,400 mg/kg). Consequently, iron is not elevated at this location for all depths. The sample collected at DY05-000 was collected from 0.5 to 1 foot and has an iron concentration of 23,000 mg/kg, which exceeds the ESL but is below the background MDC. Based on these concentrations, it is likely that iron concentrations are within background.

Pattern Recognition

Iron was detected in seven of the seven sediment samples collected in the SE AEU. Iron concentrations at the SE AEU range from 11,000 to 34,000 mg/kg, with a mean concentration of 18,857 mg/kg and a standard deviation of 8,315 mg/kg in the AEU-specific data set that excludes background samples. Iron was detected in 55 of the 55 sediment samples collected in the background data set. Iron concentrations in background range from 1,040 to 31,400 mg/kg, with a mean concentration of 9,740 mg/kg and a standard deviation of 6,739 mg/kg (Table A3.2.SE AEU.6).

The probability plot for iron indicates one population (Figure A3.4.SE AEU.10).

Risk Potential for Benthic Macroinvertebrates

The MDC for iron in SE AEU sediment (34,000 mg/kg) for the entire AEU data set including background samples exceeds the sediment ESL (20,000 mg/kg). While an MDC less than the ESL indicates that adverse effects associated with exposure to a given analyte are unlikely (EPA 1997), an MDC greater than or equal to the ESL does not indicate that risks are actually present, only that the potential for adverse effects cannot be excluded. Three of seven samples (seven of seven detected) from SE AEU sediments exceeded the ESL for iron. These samples were all collected in January 2005. The frequency of exceedances (43 percent) suggests that the potential for adverse effects cannot be excluded. The ESL is based on a LEL (NYSDEC 1994; cited in MacDonald et al. 1999). The potential for adverse effects associated with this ESL is low because the three samples greater than the iron ESL did not exceed that level by a high magnitude (HQs less than 2). Therefore, it is unlikely that iron in sediment, exceeding the screening level ESL by a low magnitude, poses a potential for adverse effects to benthic organisms in the SE AEU. Furthermore, none of the SE AEU iron concentrations in sediment are greater than the LOEC (280,000 mg/kg), and therefore, there is little potential for an adverse ecological effect.

Conclusion

The weight of evidence presented above shows that iron concentrations in sediment in the SE AEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the EU that would impact iron concentrations in sediment. It is unlikely that the concentrations of iron in sediment pose a potential for adverse effects to benthic organisms in the SE AEU. Iron is not considered an ECOPC in sediment for the SE AEU and is not further evaluated quantitatively.

4.4.4 Selenium in Sediment

Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates selenium is unlikely to be present in RFETS media as a result of historical site-related activities.

Evaluation of Spatial Trends

One of five locations, DY05-000, had a sediment concentration that exceeds the ESL (see Figure A3.4.SE AEU.4). This sample, however, did not exceed the background MDC. The sample was collected on January 10, 2005. All other locations were nondetect, although the detection limits for two sampling locations were greater than the ESL. They did not, however, exceed the background MDC. Consequently, it is likely that selenium concentrations are within background levels.

Pattern Recognition

Selenium was detected in one of the seven sediment samples collected in the SE AEU. The only detected sediment concentration is 1.70 mg/kg. This data set has a mean of 0.729 mg/kg and a standard deviation of 0.471 mg/kg in the AEU-specific data set that excludes background samples. Selenium was detected in 15 of the 54 sediment samples collected in the background data set. Selenium concentrations in background range from 0.100 to 3.20 mg/kg, with a mean concentration of 0.458 mg/kg and a standard deviation of 0.634 mg/kg (Table A3.2.SE AEU.6).

There are too few samples with detected selenium concentrations to estimate a background population for selenium.

Risk Potential for Benthic Macroinvertebrates

The MDC for selenium in SE AEU sediment (1.7 mg/kg) for the entire AEU data set including background samples exceeded the sediment ESL (0.95 mg/kg). While an MDC less than the ESL indicates that adverse effects associated with exposure to a given analyte are unlikely (EPA 1997), an MDC greater than or equal to the ESL does not indicate that risks are actually present, only that the potential for adverse effects cannot be excluded. Only one detected sample (one of seven detected) from SE AEU sediments exceeds the ESL for selenium. This sample was collected in January 2005. This low frequency of exceedances (14 percent) suggests that potential adverse effects may not be widely distributed within the SE AEU. This ESL was based on the 85th percentile concentration in streams (TNRCC 1996; cited in MacDonald et al. 1999), which defined the SQG by TNRCC. The potential for adverse effects associated with this ESL is low, because the single sample that exceeds the selenium ESL did not exceed by a high magnitude (HQs less than 2). Therefore, despite the MDC exceeding the screening level ESL, the magnitude of this exceedance is low and it is, therefore, unlikely that the selenium in sediment poses a potential for adverse effects to benthic organisms in SE AEU. Furthermore, none of the SE AEU selenium concentrations in sediment are greater than the LOEC (1.73 mg/kg), and therefore, there is little potential for an adverse ecological effect.

Conclusion

The weight of evidence presented above shows that selenium concentrations in sediment in the SE AEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the EU that would impact selenium concentrations in sediment. It is unlikely that the concentrations of selenium in sediment pose a potential for adverse effects to benthic organisms in the SE AEU. Selenium is not considered an ECOPC in sediment for the SE AEU and is not further evaluated quantitatively.

4.4.5 Dissolved Silver in Surface Water

Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates a potential for silver to have been released into RFETS media because of the metal inventory and presence of silver in waste generated during former operations. However, the localized documented source areas are remote from SE AEU.

Evaluation of Spatial Trends

The surface water ESL for dissolved silver (0.00032 mg/L) was consistently exceeded at SW130 and D1. These surface water sampling locations are located at the eastern and western ends of SE AEU, respectively (see Figure A3.4.SE AEU.5). All ESL exceedances are below 0.004 mg/L (see Figures A3.4.SE AEU.6 and A3.4.SE AEU.7), which is less than the maximum background concentration of 0.022 mg/L.

Pattern Recognition

Silver was detected in the only surface water sample collected in the SE AEU that is not designated as a background location. The one detected silver concentration at the SE AEU is 0.003 mg/L in the AEU-specific data set that excludes background samples. Silver was detected in eight of the 141 surface water samples collected in the background data set. Silver concentrations in background range from 0.002 to 0.022 mg/L, with a mean concentration of 0.003 mg/L and a standard deviation of 0.003 mg/L (Table A3.2.SE AEU.6).

The probability plot for silver indicates one population (Figure A3.4.SE AEU.11).

Risk Potential for Water Column Organisms

The MDC for dissolved silver in SE AEU surface water (0.003 mg/L) for the entire AEU data set including background samples exceeds the ESL (0.00032 mg/L). While an MDC less than the ESL indicates that adverse effects associated with exposure to a given analyte are unlikely (EPA 1997), an MDC greater than or equal to the ESL does not indicate that risks are actually present, only that the potential for adverse effects cannot be excluded. A total of two detected samples (2 of 7 detected) from SE AEU surface waters exceeds the ESL for silver. The samples that exceed the silver ESL did not exceed by a high magnitude (HQs less than or equal to 10). Therefore, it is unlikely that the potential for adverse effects from silver in surface water at SE AEU exists.

Conclusion

The weight of evidence presented above shows that silver concentrations in surface water in the SE AEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the SE AEU that would impact silver concentrations in surface water. The MDC for silver (dissolved) exceeds the AEU-specific ESL (HQ=2.9), but by a low magnitude; therefore, it is unlikely that the potential for adverse effects from silver in surface water at SE AEU exists. Silver is not considered an ECOPC in surface water for the SE AEU and, therefore, is not further evaluated quantitatively.

5.0 REFERENCES

CDPHE, 2005. Colorado Department of Public Health and Environment Water Quality Control Commission Regulation No. 31. The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31).

DOE, 2005. Final Comprehensive Risk Assessment Work Plan and Methodology, Revision 1, Rocky Flats Environmental Technology Site, Golden, Colorado. September.

EPA, 1997. Ecological Risk Assessment for Superfund: Process for Designing and Conducting Ecological Risk Assessments. Interim Final. Washington, D.C. July.

MacDonald, D.D., T. Berger, K. Wood, J. Brown, T. Johnsen, M.L. Haines, K. Brydges, M.J. MacDonald, S.L. Smith, and D.P. Shaw, 1999. A Compendium of Environmental Quality Benchmarks. GBEI/EC-99-001. ISBN 0-662-28624-3. Prepared for Environment Canada, Vancouver, B.C., Canada.

NYSDEC (New York State Department of Environmental Conservation) 1994. Technical Guidance for Screening Contaminated Sediments. Division of Fish and Wildlife, Division of Marine Resources, Albany, New York.

TNRCC (Texas Natural Resource Conservation Commission) 1996. The Surface Water Quality Monitoring Program Supplementary Information Manual, Statewide Percentile Report. Water Planning and Assessment Division, Texas Natural Resource Conservation Commission, Austin, Texas.

TABLES

Table A3.2.NN AEU.1
Statistical distribution and Comparison to Background for Surface Water, Total Analyses (excluding background samples)
No Name Gulch Aquatic Exposure Unit (NN AEU)

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test		
		Background			NN AEU (excluding background samples)			Test	1 - p	Statistically Greater than Background?
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Aluminum	mg/L	166	NONPARAMETRIC	81.9	56	NONPARAMETRIC	85.7	WRS	0.992	No
Ammonia	**mg/L**	**1**	**0**	**0.0**	**3**	**0**	**33.3**	**N/A**	**N/A**	**N/A**
Barium	**mg/L**	**172**	**NONPARAMETRIC**	**77.9**	**58**	**NONPARAMETRIC**	**100.0**	**WRS**	**0**	**Yes**
Beryllium	**mg/L**	**167**	**NONPARAMETRIC**	**12.6**	**57**	**NONPARAMETRIC**	**24.6**	**N/A**	**N/A**	**N/A**
Iron	mg/L	172	NONPARAMETRIC	96.5	57	NONPARAMETRIC	100.0	WRS	0.325	No
Lithium	**mg/L**	**166**	**NONPARAMETRIC**	**49.4**	**49**	**NONPARAMETRIC**	**95.9**	**WRS**	**7.38E-09**	**Yes**
Vanadium	mg/L	171	NONPARAMETRIC	33.9	58	LOGNORMAL	48.3	WRS	0.979	No

WRS = Wilcoxon Rank Sum
N/A = not applicable; site and/or background detection frequency less than 20%.
Bold = indicate ECOIs retained for further consideration in the upper-bound EPC comparison step.

Table A3.2.NN AEU.2
Summary Statistics For Surface Water, Total Analyses (excluding background samples)
No Name Gulch Aquatic Exposure Unit (NN AEU)[a]

Analyte	Units	Background					NN AEU (excluding background samples)				
		Total Samples	Minimum	Maximum	Mean	Standard Deviation	Total Samples	Minimum	Maximum	Mean	Standard Deviation
bis(2-ethylhexyl)phthalate	ug/L	18	1.00	5.00	4.58	1.31	22	0.400	34.0	5.81	6.78
Di-n-butylphthalate	ug/L	18	1.00	1.00	4.94	1.07	22	0.400	48.0	6.08	9.51
Phenanthrene	ug/L	18	N/A	N/A	5.17	0.420	23	3.50	6.00	11.3	33.5
Phenol	ug/L	18	N/A	N/A	5.17	0.420	27	3.50	5,000	380	1,137
Total Dioxins	ug/L	N/A	N/A	N/A	N/A	N/A	1	N/A	N/A	0.002	N/A
Total PAHs	ug/L	N/A	N/A	N/A	N/A	N/A	36	1.80	38.0	26.0	81.2
Aluminum	mg/L	166	0.026	129	3.39	12.5	56	0.017	55.4	3.12	9.33
Ammonia	mg/L	1	N/A	N/A	0.050	N/A	3	1.50	1.50	0.522	0.847
Barium	mg/L	172	0.009	0.630	0.079	0.079	58	0.003	0.820	0.252	0.194
Beryllium	mg/L	167	4.00E-05	0.004	8.01E-04	8.44E-04	57	3.00E-05	0.003	3.97E-04	4.41E-04
Iron	mg/L	172	0.032	88.6	3.04	10.2	57	0.016	117	15.3	30.9
Lithium	mg/L	166	0.001	0.154	0.015	0.022	49	0.006	0.098	0.028	0.027
Vanadium	mg/L	171	0.002	0.132	0.011	0.019	58	5.40E-04	0.095	0.008	0.016

[a]Statistics computed using one-half of the reported values for nondetects.
N/A = Not applicable.

Table A3.2.NN AEU.3
Statistical distribution and Comparison to Background for Surface Water, Dissolved Analyses (excluding background samples)
No Name Gulch Aquatic Exposure Unit (NN AEU)

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test		
		Background			NN AEU (excluding background samples)			Test	1 - p	Statistically Greater than Background?
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Copper	mg/L	138	NONPARAMETRIC	33.3	31	LOGNORMAL	41.9	WRS	0.988	No
Lead	**mg/L**	**133**	**NONPARAMETRIC**	**24.1**	**32**	**NONPARAMETRIC**	**15.6**	**N/A**	**N/A**	**N/A**
Selenium	**mg/L**	**133**	**NONPARAMETRIC**	**7.5**	**32**	**NONPARAMETRIC**	**9.4**	**N/A**	**N/A**	**N/A**
Silver	**mg/L**	**141**	**NONPARAMETRIC**	**5.7**	**32**	**GAMMA**	**15.6**	**N/A**	**N/A**	**N/A**
Zinc	**mg/L**	**138**	**NONPARAMETRIC**	**56.5**	**31**	**NONPARAMETRIC**	**74.2**	**WRS**	**0.068**	**Yes**

WRS = Wilcoxon Rank Sum

N/A = Not applicable; site and/or background detection frequency less than 20%.

Bold = indicate ECOIs retained for further consideration in the upper-bound EPC comparison step.

Table A3.2.NN AEU.4
Summary Statistics For Surface Water, Dissolved Analyses (excluding background samples)
No Name Gulch Aquatic Exposure Unit (NN AEU)[a]

Analyte	Units	Background					NN AEU (excluding background samples)				
		Total Samples	Minimum	Maximum	Mean	Standard Deviation	Total Samples	Minimum	Maximum	Mean	Standard Deviation
Copper	mg/L	138	0.001	0.026	0.006	0.005	31	0.002	0.012	0.004	0.003
Lead	mg/L	133	1.20E-04	0.013	0.002	0.003	32	1.00E-03	0.005	8.69E-04	8.71E-04
Selenium	mg/L	133	9.00E-04	0.009	0.002	0.002	32	0.011	0.043	0.003	0.008
Silver	mg/L	141	0.002	0.022	0.003	0.003	32	0.004	0.013	0.003	0.002
Zinc	mg/L	138	0.002	2.30	0.033	0.197	31	0.002	1.50	0.259	0.466

[a]Statistics computed using one-half of the reported values for nondetects.

Table A3.2.NN AEU.5
Statistical distribution and Comparison to Background for Sediments (excluding background samples)
No Name Gulch Aquatic Exposure Unit (NN AEU)

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test		
		Background			NN AEU (excluding background samples)			Test	1 - p	Statistically Greater than Background?
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Aluminum	**mg/kg**	**55**	**GAMMA**	**100.0**	**20**	**NORMAL**	**100.0**	**WRS**	**2.10E-06**	**Yes**
Barium	**mg/kg**	**54**	**GAMMA**	**100.0**	**20**	**GAMMA**	**100.0**	**WRS**	**6.57E-08**	**Yes**
Iron	**mg/kg**	**55**	**GAMMA**	**100.0**	**20**	**NORMAL**	**100.0**	**WRS**	**2.49E-05**	**Yes**
Lead	**mg/kg**	**55**	**LOGNORMAL**	**100.0**	**20**	**GAMMA**	**100.0**	**WRS**	**1.86E-04**	**Yes**
Manganese	mg/kg	55	GAMMA	100.0	20	GAMMA	100.0	WRS	0.305	No

WRS = Wilcoxon Rank Sum

N/A = Not applicable; site and/or background detection frequency less than 20%.

Bold = indicate ECOIs retained for further consideration in the upper-bound EPC comparison step.

Table A3.2.NN AEU.6
Summary Statistics For Sediments (excluding background samples)
No Name Gulch Aquatic Exposure Unit (NN AEU)[a]

Analyte	Units	Background					NN AEU (excluding background samples)				
		Total Samples	Minimum	Maximum	Mean	Standard Deviation	Total Samples	Minimum	Maximum	Mean	Standard Deviation
Aluminum	mg/kg	55	811	25,200	6,791	5,603	20	6,000	24,000	14,689	5,247
Barium	mg/kg	54	10.6	260	78.9	58.8	20	92.6	390	192	80.3
Iron	mg/kg	55	1,040	31,400	9,740	6,739	20	9,050	21,500	15,513	3,194
Lead	mg/kg	55	2.60	68.8	13.3	12.4	20	12.0	37.6	20.4	5.99
Manganese	mg/kg	55	9.00	1,280	238	216	20	78.0	1,100	254	226
Benzo(a)anthracene	ug/kg	43	37.0	1,700	434	335	16	42.0	150	220	146
Benzo(a)pyrene	ug/kg	43	120	900	407	260	16	98.0	160	316	131
Benzo(g,h,i)perylene	ug/kg	41	240	460	396	246	16	71.0	89.0	310	140
Chrysene	ug/kg	43	50.0	2,000	446	368	16	44.0	190	273	150
Indeno(1,2,3-cd)pyrene	ug/kg	42	220	470	388	243	16	57.0	86.0	309	142
Phenanthrene	ug/kg	43	260	3,200	527	614	16	57.0	280	237	138
Pyrene	ug/kg	43	61.0	4,700	536	742	16	210	320	333	113
Total PAHs	ug/kg	N/A	N/A	N/A	N/A	N/A	16	1,735	4,202	3,118	989

[a]Statistics computed using one-half of the reported values for nondetects.
N/A = Not applicable.

Table A3.2.RC AEU.1
Statistical distribution and Comparison to Background for Surface Water, Total Analyses (excluding background samples)
Rock Creek Aquatic Exposure Unit (RC AEU)

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test		
		Background			RC AEU (excluding background samples)			Test	1 - p	Statistically Greater than Background?
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Aluminum	mg/L	166	NON-PARAMETRIC	82	49	LOGNORMAL	83.7	WRS	0.801	No
Barium	**mg/L**	**172**	**NON-PARAMETRIC**	**78**	**49**	**NON-PARAMETRIC**	**98.0**	**WRS**	**0.001**	**Yes**
Beryllium	**mg/L**	**167**	**NON-PARAMETRIC**	**13**	**49**	**GAMMA**	**16.3**	**N/A**	**N/A**	**N/A**
Iron	mg/L	172	NON-PARAMETRIC	97	49	GAMMA	98.0	WRS	0.958	No
Lithium	**mg/L**	**166**	**NON-PARAMETRIC**	**49**	**45**	**NON-PARAMETRIC**	**91.1**	**WRS**	**1.26E-04**	**Yes**
Vanadium	mg/L	171	NON-PARAMETRIC	34	49	LOGNORMAL	55.1	WRS	1.000	No

WRS = Wilcoxon Rank Sum
N/A = not applicable; site and/or background detection frequency less than 20%.
Bold = indicate ECOIs retained for further consideration in the upper-bound EPC comparison step.

Table A3.2.RC AEU.2
Summary Statistics For Surface Water, Total Analyses (excluding background samples)
Rock Creek Aquatic Exposure Unit RC AEU)[a]

Analyte	Units	Background					RC AEU (excluding background samples)				
		Total Samples	Minimum	Maximum	Mean	Standard Deviation	Total Samples	Minimum	Maximum	Mean	Standard Deviation
Aluminum	mg/L	166	0.026	129	3.39	12.5	49	0.018	11.6	1.25	2.23
Barium	mg/L	172	0.009	0.630	0.079	0.079	49	0.003	0.132	0.080	0.025
Beryllium	mg/L	167	4.00E-05	0.004	8.01E-04	8.44E-04	49	3.00E-05	8.00E-04	2.54E-04	2.17E-04
Iron	mg/L	172	0.032	88.6	3.04	10.2	49	0.014	8.10	1.12	1.76
Lithium	mg/L	166	0.001	0.154	0.015	0.022	45	0.004	0.113	0.013	0.016
Vanadium	mg/L	171	0.002	0.132	0.011	0.019	49	3.80E-04	0.024	0.004	0.004

[a]Statistics computed using one-half of the reported values for nondetects.
N/A = Not applicable.

Table A3.2.RC AEU.3
Statistical distribution and Comparison to Background for Surface Water, Dissolved Analyses (excluding background samples)
Rock Creek Aquatic Exposure Unit (RC AEU)

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test		
		Background			RC AEU (excluding background samples)			Test	1 - p	Statistically Greater than Background?
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Cadmium	**mg/L**	**136**	**NON-PARAMETRIC**	**7**	**13**	**GAMMA**	**7.7**	**N/A**	**N/A**	**N/A**
Copper	mg/L	138	NON-PARAMETRIC	33	13	GAMMA	76.9	WRS	0.336	No
Lead	**mg/L**	**133**	**NON-PARAMETRIC**	**24**	**13**	**NON-PARAMETRIC**	**7.7**	**N/A**	**N/A**	**N/A**

WRS = Wilcoxon Rank Sum
N/A = not applicable; site and/or background detection frequency less than 20%.
Bold = indicate ECOIs retained for further consideration in the upper-bound EPC comparison step.

Table A3.2.RC AEU.4
Summary Statistics For Surface Water, Dissolved Analyses (excluding background samples)
Rock Creek Aquatic Exposure Unit RC AEU)[a]

Analyte	Units	Background					RC AEU (excluding background samples)				
		Total Samples	Minimum	Maximum	Mean	Standard Deviation	Total Samples	Minimum	Maximum	Mean	Standard Deviation
Cadmium	mg/L	136	1.00E-03	0.017	0.002	0.001	13	0.003	0.003	0.002	5.27E-04
Copper	mg/L	138	0.001	0.026	0.006	0.005	13	0.003	0.022	0.008	0.007
Lead	mg/L	133	1.20E-04	0.013	0.002	0.003	13	0.002	0.002	6.42E-04	3.16E-04

[a]Statistics computed using one-half of the reported values for nondetects.
N/A = Not applicable.

Table A3.2.RC AEU.5
Statistical distribution and Comparison to Background for Sediments (excluding background samples)
Rock Creek Aquatic Exposure Unit (RC AEU)

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test		
		Background			RC AEU (excluding background samples)			Test	1 - p	Statistically Greater than Background?
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Aluminum	**mg/kg**	**55**	**GAMMA**	**100.0**	**12**	**NORMAL**	**100.0**	**WRS**	**3.46E-04**	**Yes**
Antimony	**mg/kg**	**47**	**LOGNORMAL**	**10.6**	**12**	**NORMAL**	**0.0**	**N/A**	**N/A**	**N/A**
Arsenic	**mg/kg**	**55**	**GAMMA**	**89.1**	**12**	**GAMMA**	**100.0**	**WRS**	**1.95E-03**	**Yes**
Barium	**mg/kg**	**54**	**GAMMA**	**100.0**	**12**	**NORMAL**	**100.0**	**WRS**	**2.26E-04**	**Yes**
Cadmium	**mg/kg**	**48**	**LOGNORMAL**	**10.4**	**12**	**NORMAL**	**41.7**	**N/A**	**N/A**	**N/A**
Iron	**mg/kg**	**55**	**GAMMA**	**100.0**	**12**	**LOGNORMAL**	**100.0**	**WRS**	**1.62E-03**	**Yes**
Lead	**mg/kg**	**55**	**LOGNORMAL**	**100.0**	**12**	**GAMMA**	**100.0**	**WRS**	**1.90E-03**	**Yes**
Manganese	mg/kg	55	GAMMA	100.0	12	NON-PARAMETRIC	100.0	WRS	4.54E-01	No
Nickel	**mg/kg**	**53**	**GAMMA**	**71.7**	**12**	**NORMAL**	**100.0**	**WRS**	**0.001**	**Yes**
Selenium	**mg/kg**	**54**	**NON-PARAMETRIC**	**27.8**	**12**	**NORMAL**	**25.0**	**WRS**	**0.044**	**Yes**
Silver	**mg/kg**	**48**	**NON-PARAMETRIC**	**6.3**	**12**	**NORMAL**	**16.7**	**N/A**	**N/A**	**N/A**
Zinc	**mg/kg**	**55**	**NON-PARAMETRIC**	**98.2**	**12**	**NORMAL**	**100.0**	**WRS**	**0.009**	**Yes**

WRS = Wilcoxon Rank Sum
N/A = Not applicable; site and/or background detection frequency less than 20%.
Bold = indicate ECOIs retained for further consideration in the upper-bound EPC comparison step.

Table A3.2.RC AEU.6
Summary Statistics For Sediments (excluding background samples) RC AEU [a]

Analyte	Units	Background					RC AEU (excluding background samples)				
		Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation
Aluminum	mg/kg	55	811	25,200	6,791	5,603	12	4,900	19,000	12,092	3,754
Antimony	mg/kg	47	1.00	12.4	3.64	3.21	12	N/A	N/A	2.60	2.20
Arsenic	mg/kg	55	0.270	8.70	2.43	1.92	12	1.70	15.0	4.85	3.82
Barium	mg/kg	54	10.6	260	78.9	58.8	12	52.0	360	165	86.6
Cadmium	mg/kg	48	0.410	1.30	0.525	0.345	12	0.210	1.10	0.580	0.231
Iron	mg/kg	55	1,040	31,400	9,740	6,739	12	7,800	39,000	16,633	9,246
Lead	mg/kg	55	2.60	68.8	13.3	12.4	12	6.60	79.1	25.7	19.6
Manganese	mg/kg	55	9.00	1,280	238	216	12	80.2	2,500	415	685
Nickel	mg/kg	53	1.20	25.6	6.93	5.32	12	6.30	23.0	12.2	4.42
Selenium	mg/kg	54	0.100	3.20	0.458	0.634	12	0.380	0.810	0.534	0.361
Silver	mg/kg	48	1.40	3.40	0.737	0.654	12	1.20	1.30	0.628	0.483
Zinc	mg/kg	55	6.50	720	72.2	129	12	29.0	95.0	62.4	18.5
Pentachlorophenol	ug/kg	43	N/A	N/A	1,980	1,221	12	1,500	1,500	2,213	1,593
Total PAHs	ug/kg	N/A	N/A	N/A	N/A	N/A	12	414	1,330	3,000	2,245

N/A = Not applicable.

Table A3.2.MK AEU.1
Statistical distribution and Comparison to Background for Surface Water, Total Analyses (excluding background samples)
McKay Ditch Aquatic Exposure Unit (MK AEU)

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test		
		Background			MK AEU (excluding background samples)			Test	1 - p	Statistically Greater than Background?
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Aluminum	**mg/L**	**166**	**NON-PARAMETRIC**	**82**	**33**	**LOGNORMAL**	**100.0**	**WRS**	**0.000**	**Yes**
Iron	**mg/L**	**172**	**NON-PARAMETRIC**	**97**	**32**	**LOGNORMAL**	**100.0**	**WRS**	**0.000**	**Yes**
Vanadium	mg/L	171	NON-PARAMETRIC	34	33	LOGNORMAL	54.5	WRS	0.683	No

WRS = Wilcoxon Rank Sum
N/A = not applicable; site and/or background detection frequency less than 20%.
Bold = indicate ECOIs retained for further consideration in the upper-bound EPC comparison step.

Table A3.2.MK AEU.2
Summary Statistics For Surface Water, Total Analyses (excluding background samples)
McKay Ditch Aquatic Exposure Unit (MK AEU)[a]

Analyte	Units	Background					MK AEU (excluding background samples)				
		Total Samples	Minimum	Maximum	Mean	Standard Deviation	Total Samples	Minimum	Maximum	Mean	Standard Deviation
Aluminum	mg/L	166	0.026	129	3.39	12.5	33	0.088	46.0	4.54	8.27
Iron	mg/L	172	0.032	88.600	3.044	10.209	32	0.087	42.000	4.222	7.412
Vanadium	mg/L	171	1.60E-03	0.132	1.07E-02	1.94E-02	33	6.80E-04	8.20E-02	8.66E-03	1.54E-02

[a]Statistics computed using one-half of the reported values for nondetects.
N/A = Not applicable.

Table A3.2.MK AEU.3
Statistical distribution and Comparison to Background for Surface Water, Dissolved Analyses (excluding background samples)
McKay Ditch Aquatic Exposure Unit (MK AEU)

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test		
		Background			MK AEU (excluding background samples)			Test	1 - p	Statistically Greater than Background?
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Cadmium	**mg/L**	**136**	**NON-PARAMETRIC**	**7**	**20**	**GAMMA**	**25.0**	**N/A**	**N/A**	**N/A**
Copper	mg/L	138	NON-PARAMETRIC	33	19	LOGNORMAL	73.7	WRS	0.373	No
Lead	mg/L	133	NON-PARAMETRIC	24	19	NON-PARAMETRIC	63.2	WRS	0.430	No
Silver	**mg/L**	**141**	**NON-PARAMETRIC**	**6**	**20**	**NON-PARAMETRIC**	**5.0**	**N/A**	**N/A**	**N/A**
Zinc	**mg/L**	**138**	**NON-PARAMETRIC**	**57**	**20**	**GAMMA**	**85.0**	**WRS**	**0.001**	**Yes**

WRS = Wilcoxon Rank Sum
N/A = not applicable; site and/or background detection frequency less than 20%.
Bold = indicate ECOIs retained for further consideration in the upper-bound EPC comparison step.

Table A3.2.MK AEU.4
Summary Statistics For Surface Water, Dissolved Analyses (excluding background samples)
McKay Ditch Aquatic Exposure Unit (MK AEU)[a]

Analyte	Units	Background					MK AEU (excluding background samples)				
		Total Samples	Minimum	Maximum	Mean	Standard Deviation	Total Samples	Minimum	Maximum	Mean	Standard Deviation
Cadmium	mg/L	136	1.00E-03	0.017	0.002	0.001	20	0.000	0.003	0.001	8.82E-04
Copper	mg/L	138	1.15E-03	0.026	0.006	0.005	19	2.70E-03	0.025	0.006	0.005
Lead	mg/L	133	0.000	0.013	0.002	0.003	19	0.000	0.071	0.008	0.017
Silver	mg/L	141	2.20E-03	0.022	0.003	0.003	20	0.002	0.002	9.71E-04	1.19E-03
Zinc	mg/L	138	2.40E-03	2.300	3.32E-02	1.97E-01	20	5.50E-03	0.245	4.62E-02	5.75E-02

[a]Statistics computed using one-half of the reported values for nondetects.
N/A = Not applicable.

Table A3.2.MK AEU.5
Statistical distribution and Comparison to Background for Sediments (excluding background samples)
McKay Ditch Aquatic Exposure Unit (MK AEU)

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test		
		Background			MK AEU (excluding background samples)			Test	1 - p	Statistically Greater than Background?
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Aluminum	**mg/kg**	**55**	**GAMMA**	**100.0**	**6**	**NORMAL**	**100.0**	**WRS**	**2.22E-02**	**Yes**
Antimony	**mg/kg**	**47**	**LOGNORMAL**	**10.6**	**6**	**NON-PARAMETRIC**	**0.0**	**N/A**	**N/A**	**N/A**
Chromium	**mg/kg**	**55**	**GAMMA**	**85.5**	**6**	**GAMMA**	**100.0**	**WRS**	**9.96E-02**	**Yes**
Copper	mg/kg	55	GAMMA	80.0	6	GAMMA	100.0	WRS	6.24E-01	No
Fluoride	**mg/kg**	**N/A**	**N/A**	**N/A**	**1**	**0**	**100.0**	**N/A**	**N/A**	**N/A**
Iron	mg/kg	55	GAMMA	100.0	6	NORMAL	100.0	WRS	1.95E-01	No
Lead	mg/kg	55	LOGNORMAL	100.0	6	GAMMA	100.0	WRS	7.19E-01	No
Nickel	**mg/kg**	**53**	**GAMMA**	**71.7**	**6**	**NORMAL**	**100.0**	**WRS**	**3.65E-02**	**Yes**
Selenium	**mg/kg**	**54**	**NON-PARAMETRIC**	**27.8**	**6**	**LOGNORMAL**	**16.7**	**N/A**	**N/A**	**N/A**
Zinc	mg/kg	55	NON-PARAMETRIC	98.2	6	NON-PARAMETRIC	100.0	WRS	0.834	No

WRS = Wilcoxon Rank Sum
N/A = Not applicable; site and/or background detection frequency less than 20%.
Bold = indicate ECOIs retained for further consideration in the upper-bound EPC comparison step.

Table A3.2.MK AEU.6
Summary Statistics For Sediments (excluding background samples) MK AEU [a]

Analyte	Units	Background					MK AEU (excluding background samples)				
		Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation
Aluminum	mg/kg	55	811	25,200	6,791	5,603	6	3,700	30,300	13,832	10,138
Antimony	mg/kg	47	1.00	12.4	3.64	3.21	6	N/A	N/A	0.93	1.46
Chromium	mg/kg	55	1.500	30.40	8.78	7.87	6	4.00	44.3	14.73	15.17
Copper	mg/kg	55	02.2	37	10.8	08.4	6	03.1	33	11	11.4
Fluoride	mg/kg	N/A	N/A	N/A	N/A	N/A	1	8.470	8.47	8.470	N/A
Iron	mg/kg	55	1,040	31,400	9,740	6,739	6	4,200	27,500	12,017	8,347
Lead	mg/kg	55	2.60	68.8	13.3	12.4	6	2.00	73.6	17.9	27.7
Nickel	mg/kg	53	1.20	0,026	7	5	6	03.5	0,028	13	9
Selenium	mg/kg	54	0.10	03.2	0.46	0.63	6	2.70	02.7	00.7	0.98
Zinc	mg/kg	55	6.500	720.00	72.219	128.812	6	19.000	347.000	79.117	131.382
4-Methylphenol	ug/kg	44	68.00	1500.00	432.227	313.700	2	N/A	N/A	307.500	194.454
Total PAHs	ug/kg	N/A	N/A	N/A	N/A	N/A	2	586.0	586.0	633.0	66.5

N/A = Not applicable.

Table A3.2.SE AEU.1
Statistical distribution and Comparison to Background for Surface Water, Total Analyses (excluding background samples)
Southeast Buffer Zone Aquatic Exposure Unit (SE AEU)

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test		
		Background			SE AEU (excluding background samples)			Test	1 - p	Statistically Greater than Background?
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Aluminum	mg/L	166	NON-PARAMETRIC	82	6	NORMAL	50.0	WRS	0.998	No

WRS = Wilcoxon Rank Sum
N/A = not applicable; site and/or background detection frequency less than 20%.
Bold = indicate ECOIs retained for further consideration in the upper-bound EPC comparison step.

Table A3.2.SE AEU.2
Summary Statistics For Surface Water, Total Analyses (excluding background samples)
Southeast Buffer Zone Aquatic Exposure Unit (MK AEU)[a]

Analyte	Units	Background					MK AEU (excluding background samples)				
		Total Samples	Minimum	Maximum	Mean	Standard Deviation	Total Samples	Minimum	Maximum	Mean	Standard Deviation
Aluminum	mg/L	166	2.63E-02	129.000	3.39E+00	1.25E+01	6	6.10E-02	1.60E-01	6.48E-02	5.12E-02

[a]Statistics computed using one-half of the reported values for nondetects.
N/A = Not applicable.

Table A3.2.SE AEU.3
Statistical distribution and Comparison to Background for Surface Water, Dissolved Analyses (excluding background samples)
Southeast Buffer Zone Aquatic Exposure Unit (SE AEU)

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test		
		Background			SE AEU (excluding background samples)			Test	1 - p	Statistically Greater than Background?
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Silver	mg/L	141	NON-PARAMETRIC	6	1	0	100	N/A	N/A	N/A

WRS = Wilcoxon Rank Sum
N/A = not applicable; site and/or background detection frequency less than 20%.
Bold = indicate ECOIs retained for further consideration in the upper-bound EPC comparison step.

Table A3.2.SE AEU.4
Summary Statistics For Surface Water, Total Analyses (excluding background samples)
Southeast Buffer Zone Aquatic Exposure Unit (SE AEU)[a]

Analyte	Units	Background					SE AEU (excluding background samples)				
		Total Samples	Minimum	Maximum	Mean	Standard Deviation	Total Samples	Minimum	Maximum	Mean	Standard Deviation
Silver	mg/L	141	2.20E-03	0.022	0.003	0.003	1	0.003	0.003	0.003	N/A

[a]Statistics computed using one-half of the reported values for nondetects.
N/A = Not applicable.

Table A3.2.SE AEU.5
Statistical distribution and Comparison to Background for Sediments (excluding background samples)
Southeast Buffer Zone Aquatic Exposure Unit (SE AEU)

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test		
		Background			SE AEU (excluding background samples)			Test	1 - p	Statistically Greater than Background?
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Aluminum	**mg/kg**	**55**	**GAMMA**	**100.0**	**7**	**NORMAL**	**100.0**	**WRS**	**2.50E-04**	**Yes**
Barium	**mg/kg**	**54**	**GAMMA**	**100.0**	**7**	**NORMAL**	**100.0**	**WRS**	**1.26E-03**	**Yes**
Iron	**mg/kg**	**55**	**GAMMA**	**100.0**	**7**	**NORMAL**	**100.0**	**WRS**	**1.29E-03**	**Yes**
Selenium	**mg/kg**	**54**	**NON-PARAMETRIC**	**27.8**	**7**	**NON-PARAMETRIC**	**14.3**	**N/A**	**N/A**	**N/A**

WRS = Wilcoxon Rank Sum

N/A = Not applicable; site and/or background detection frequency less than 20%.

Bold = indicate ECOIs retained for further consideration in the upper-bound EPC comparison step.

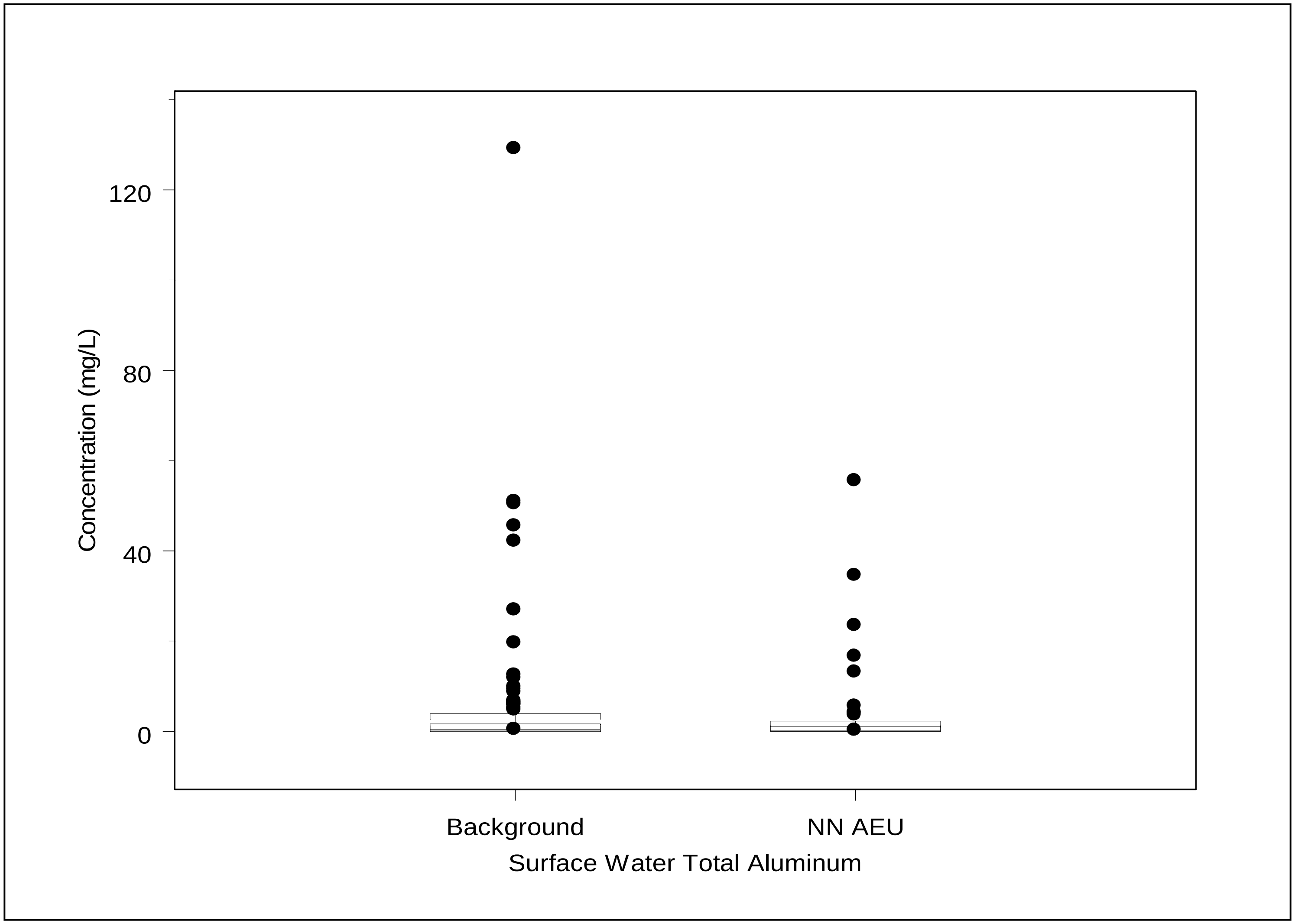
Table A3.2.SE AEU.6
Summary Statistics For Sediments (excluding background samples) SE AEU [a]

Analyte	Units	Background					SE AEU (excluding background samples)				
		Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation
Aluminum	mg/kg	55	811	25,200	6,791	5,603	7	7,600	26,000	18,229	6,295
Barium	mg/kg	54	10.6	260	78.9	58.8	7	77.0	240	158	51.6
Iron	mg/kg	55	1,040	31,400	9,740	6,739	7	11,000	34,000	18,857	8,315
Selenium	mg/kg	54	0.100	3.20	0.458	0.634	7	1.70	1.70	0.729	0.471

N/A = Not applicable.

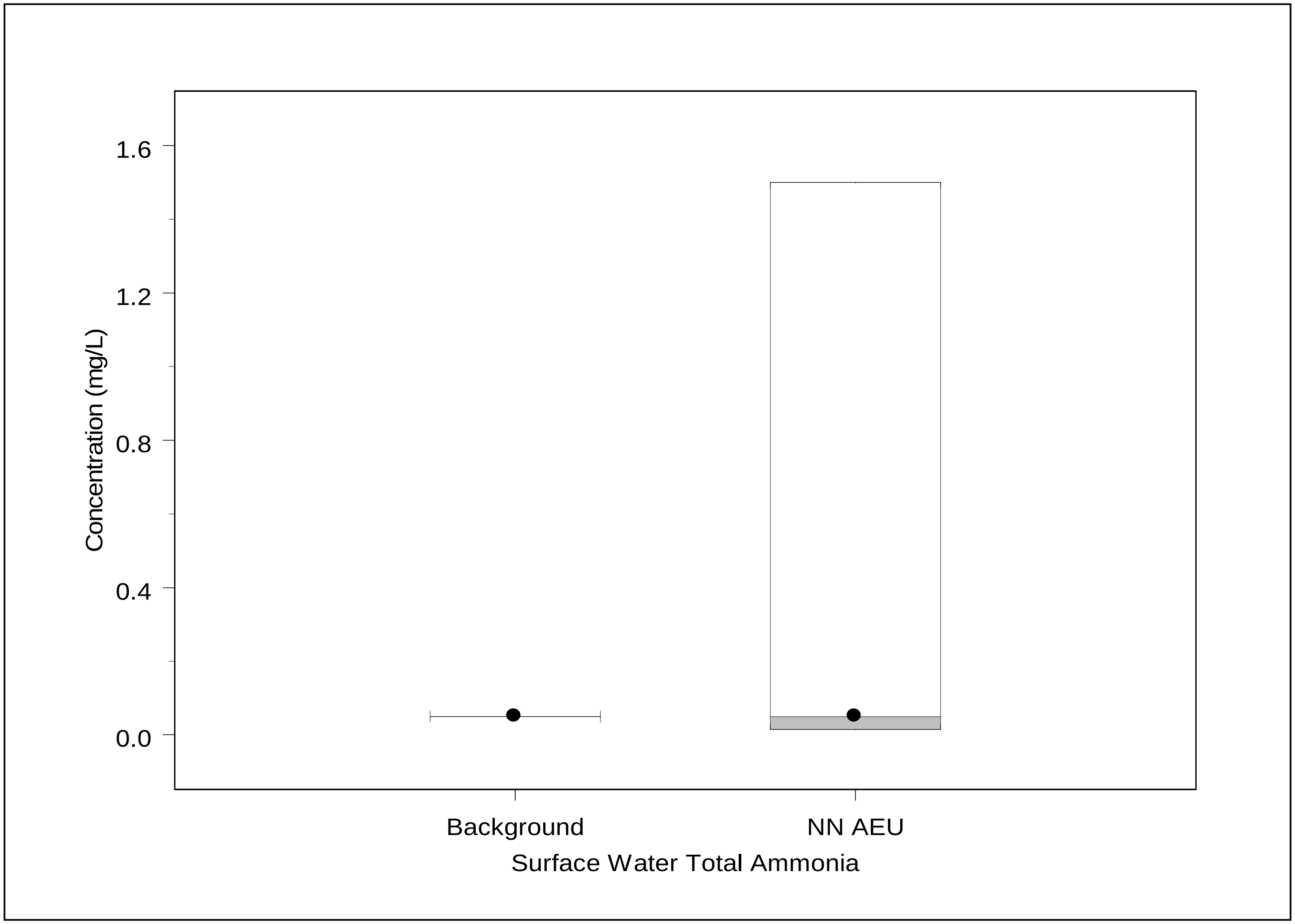
FIGURES

Figure A3.2.NN AEU.1
NN AEU Surface Water Total Box Plots for Aluminum



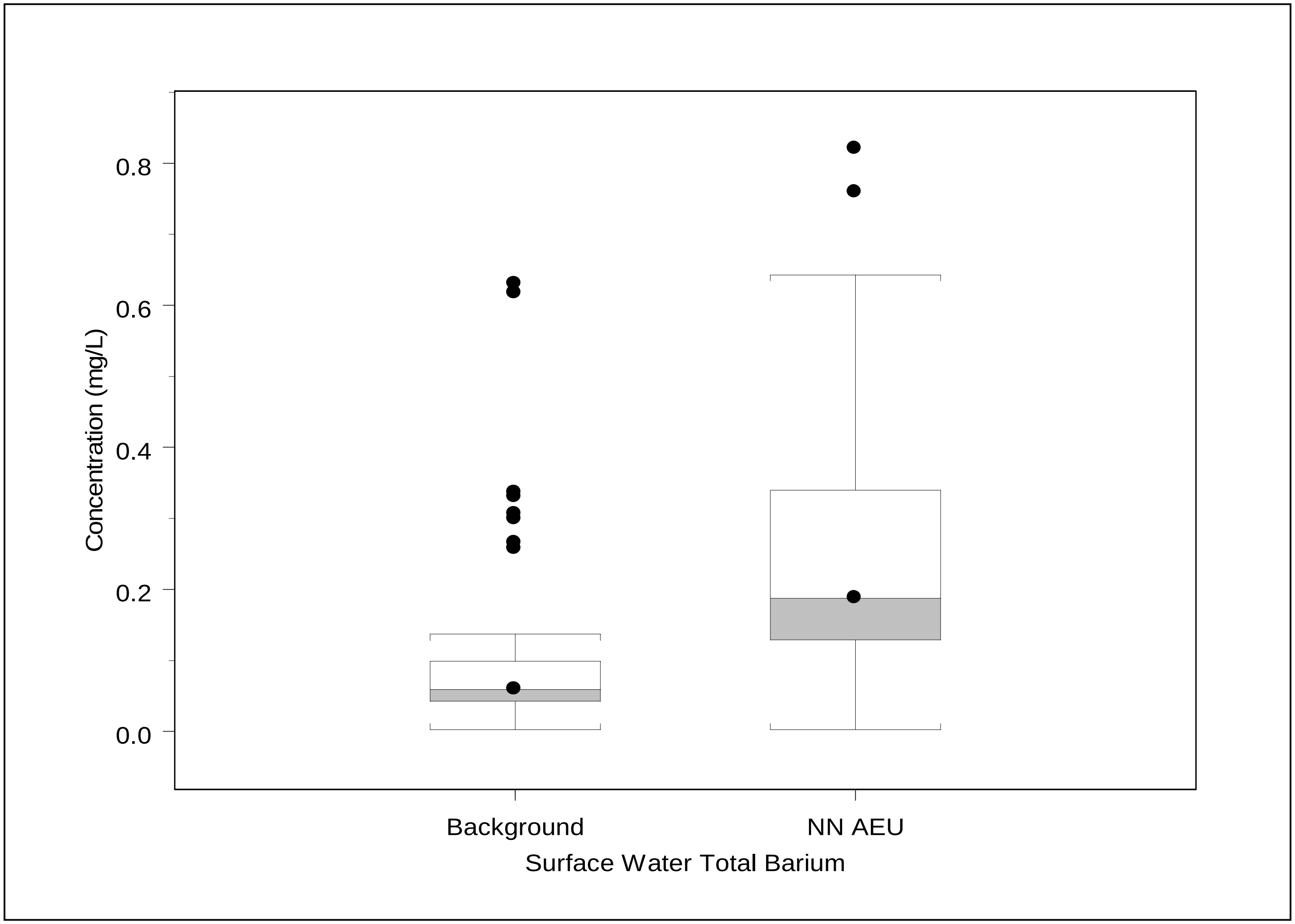
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.2
NN AEU Surface Water Total Box Plots for Ammonia



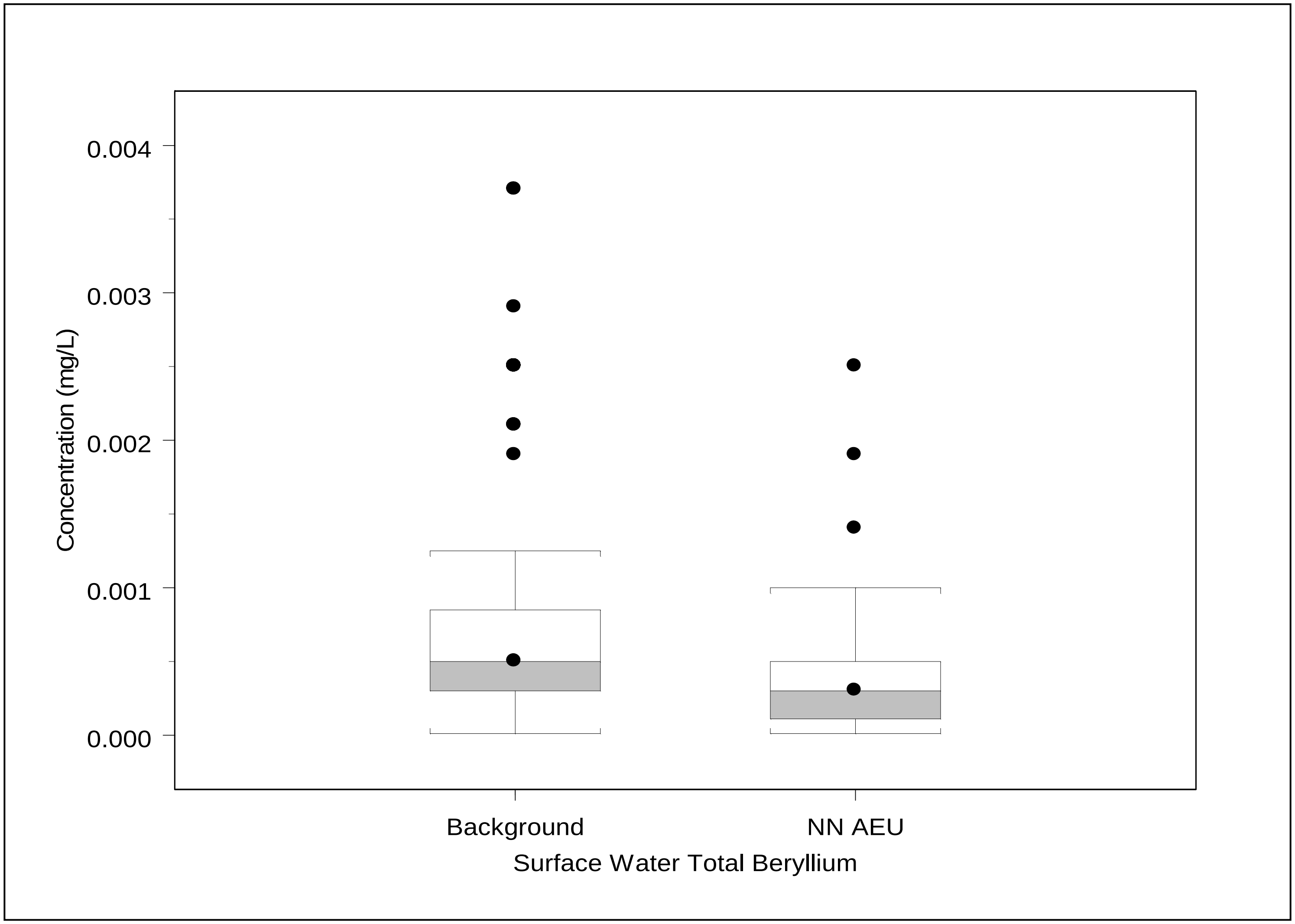
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.3
NN AEU Surface Water Total Box Plots for Barium



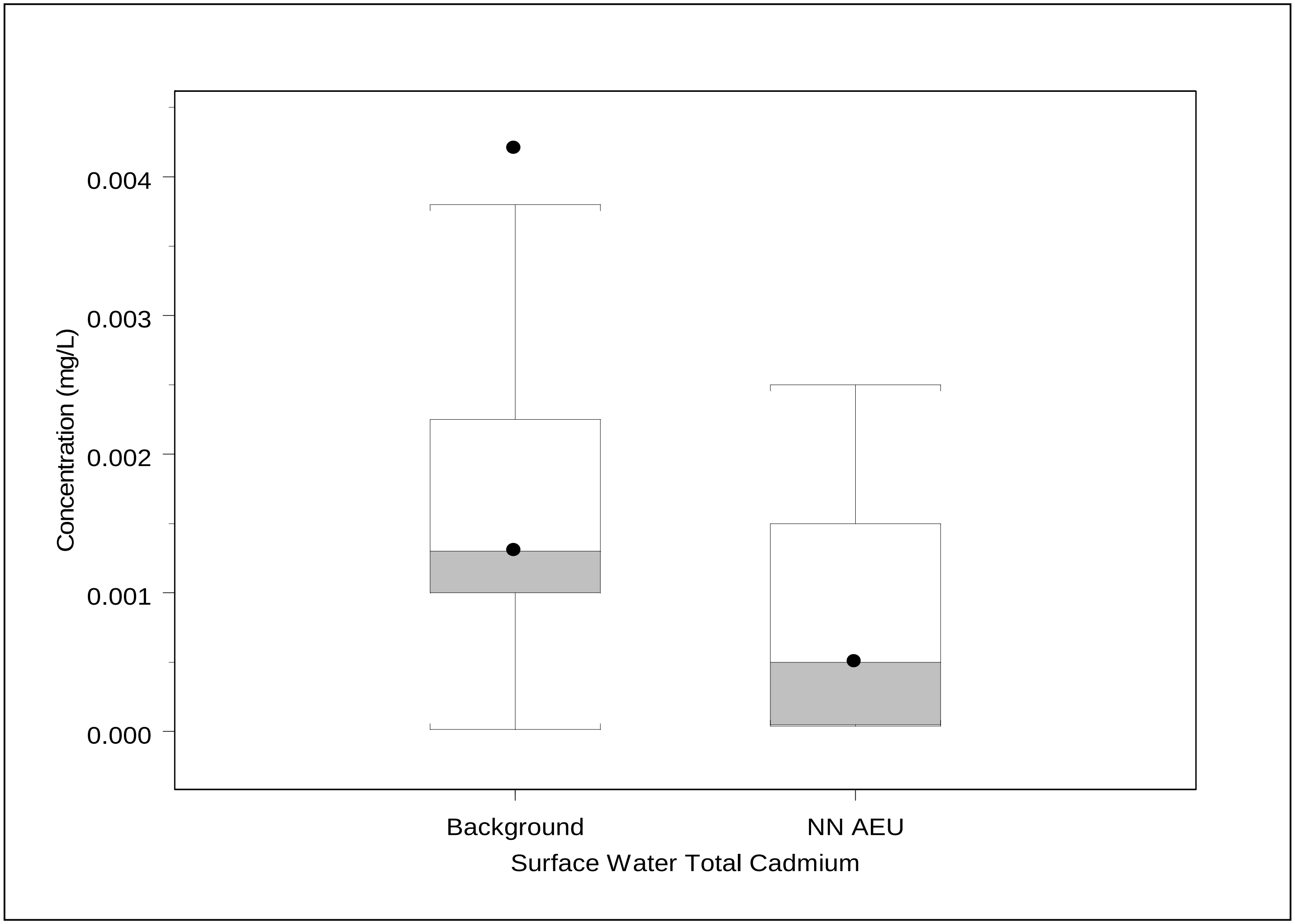
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.4
NN AEU Surface Water Total Box Plots for Beryllium



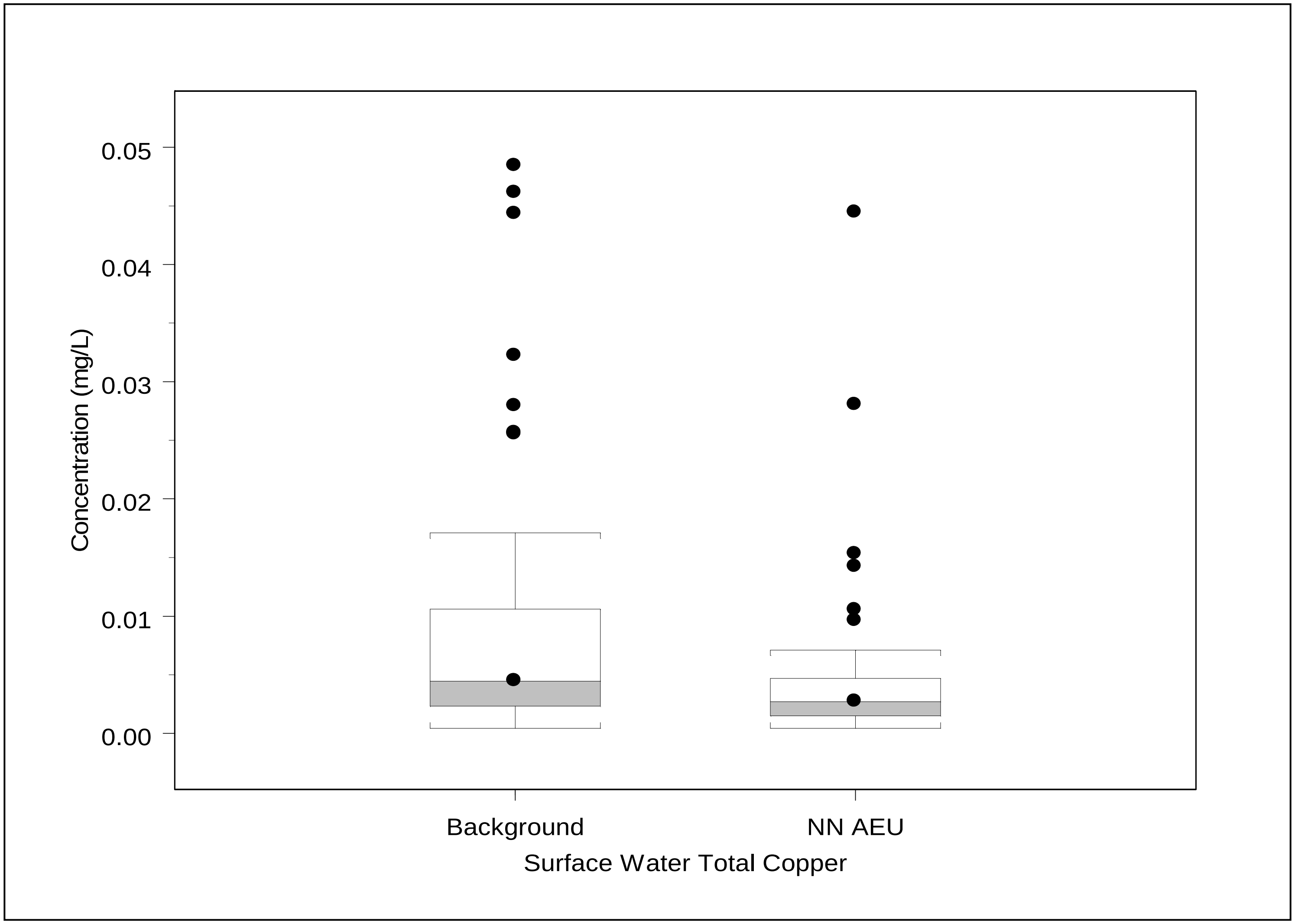
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.5
NN AEU Surface Water Total Box Plots for Cadmium



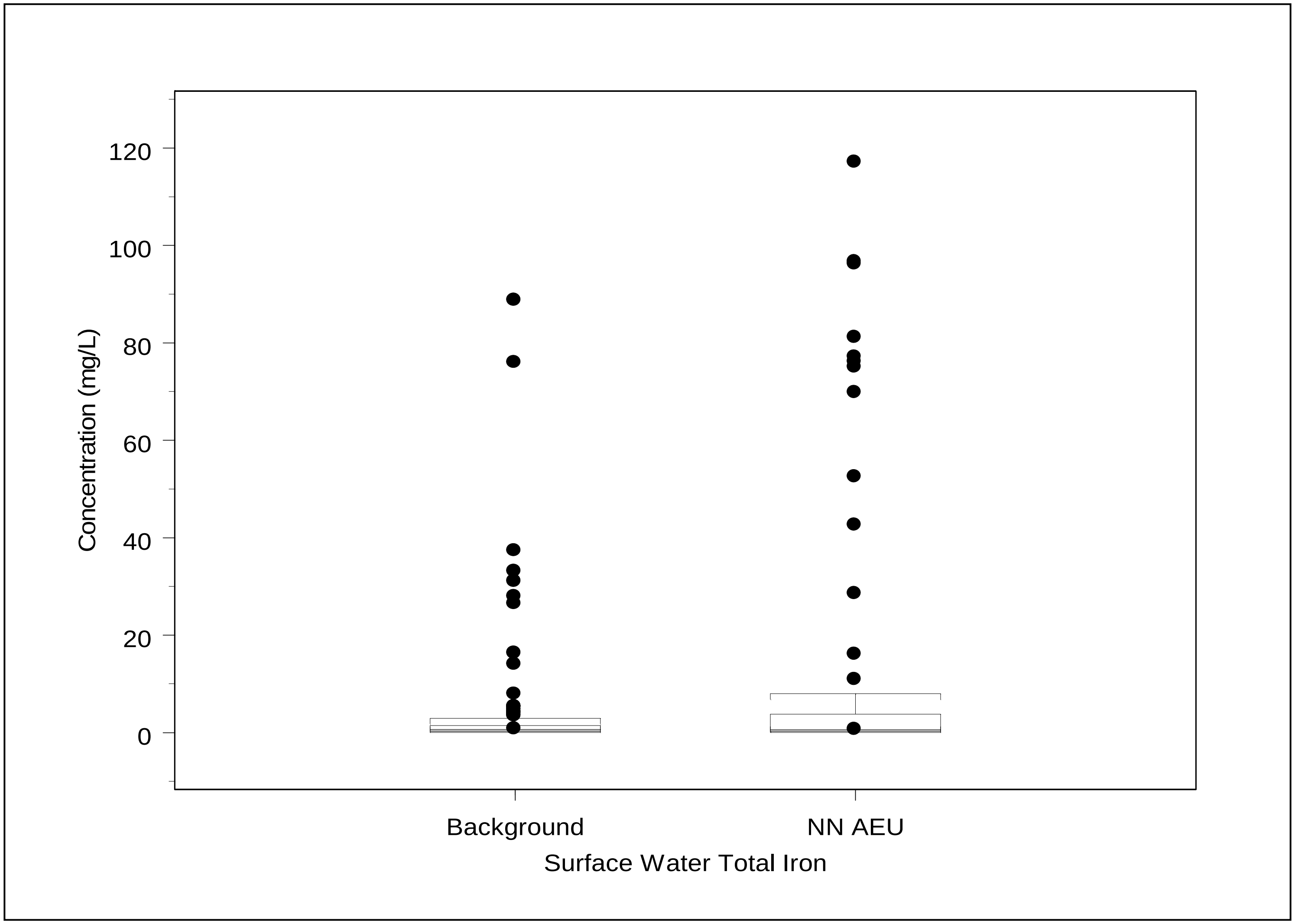
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.6
NN AEU Surface Water Total Box Plots for Copper



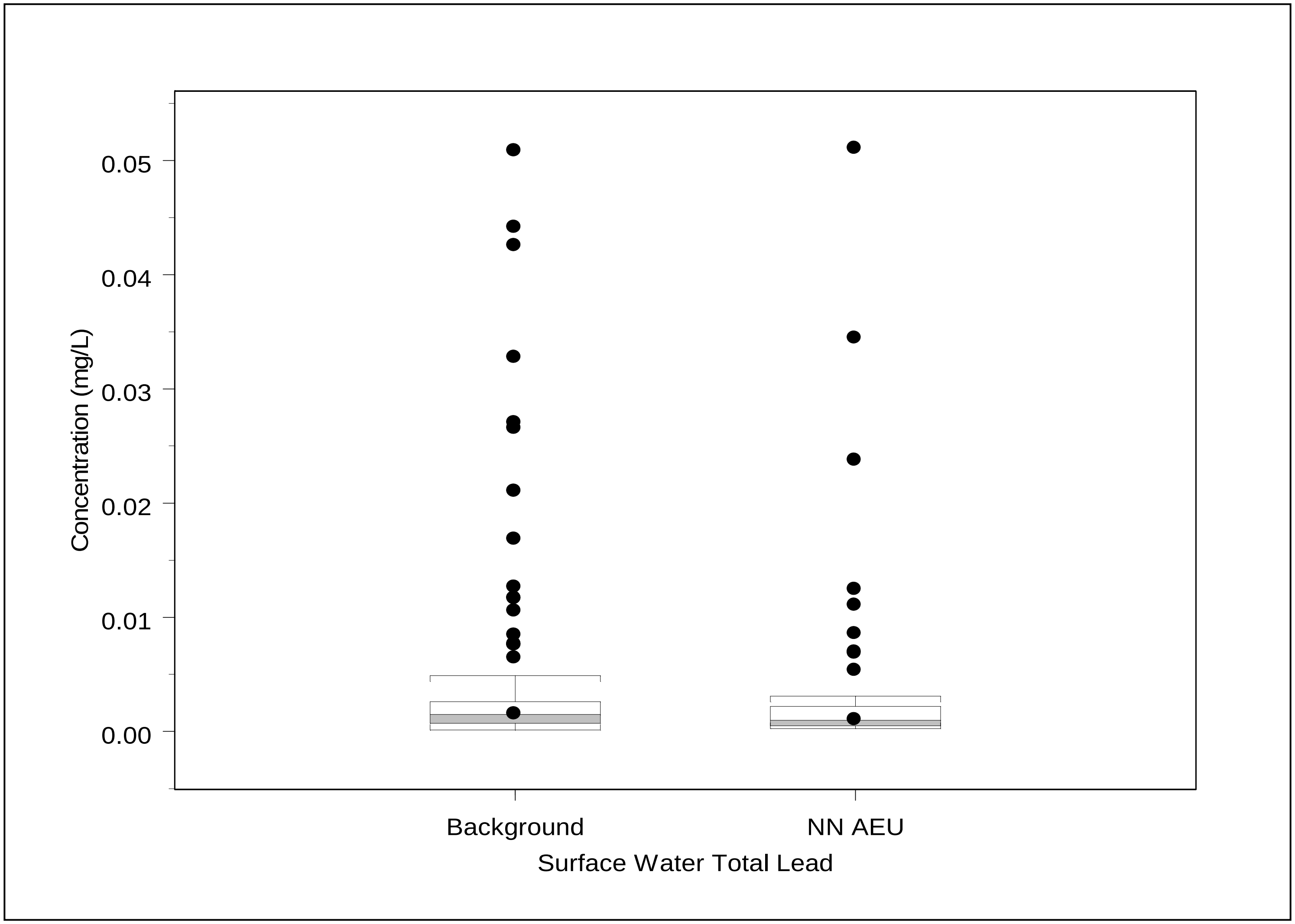
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.7
NN AEU Surface Water Total Box Plots for Iron



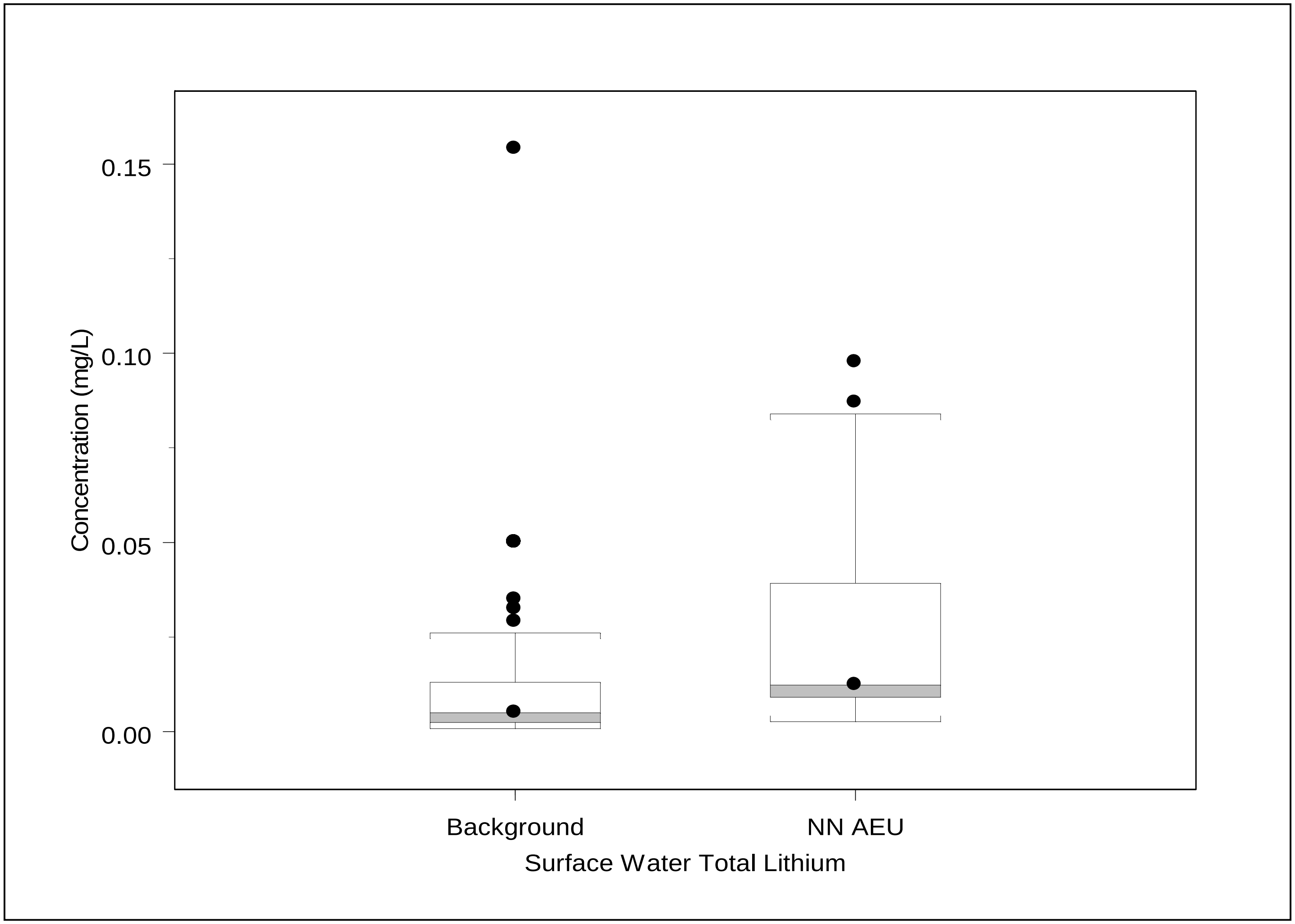
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.8
NN AEU Surface Water Total Box Plots for Lead



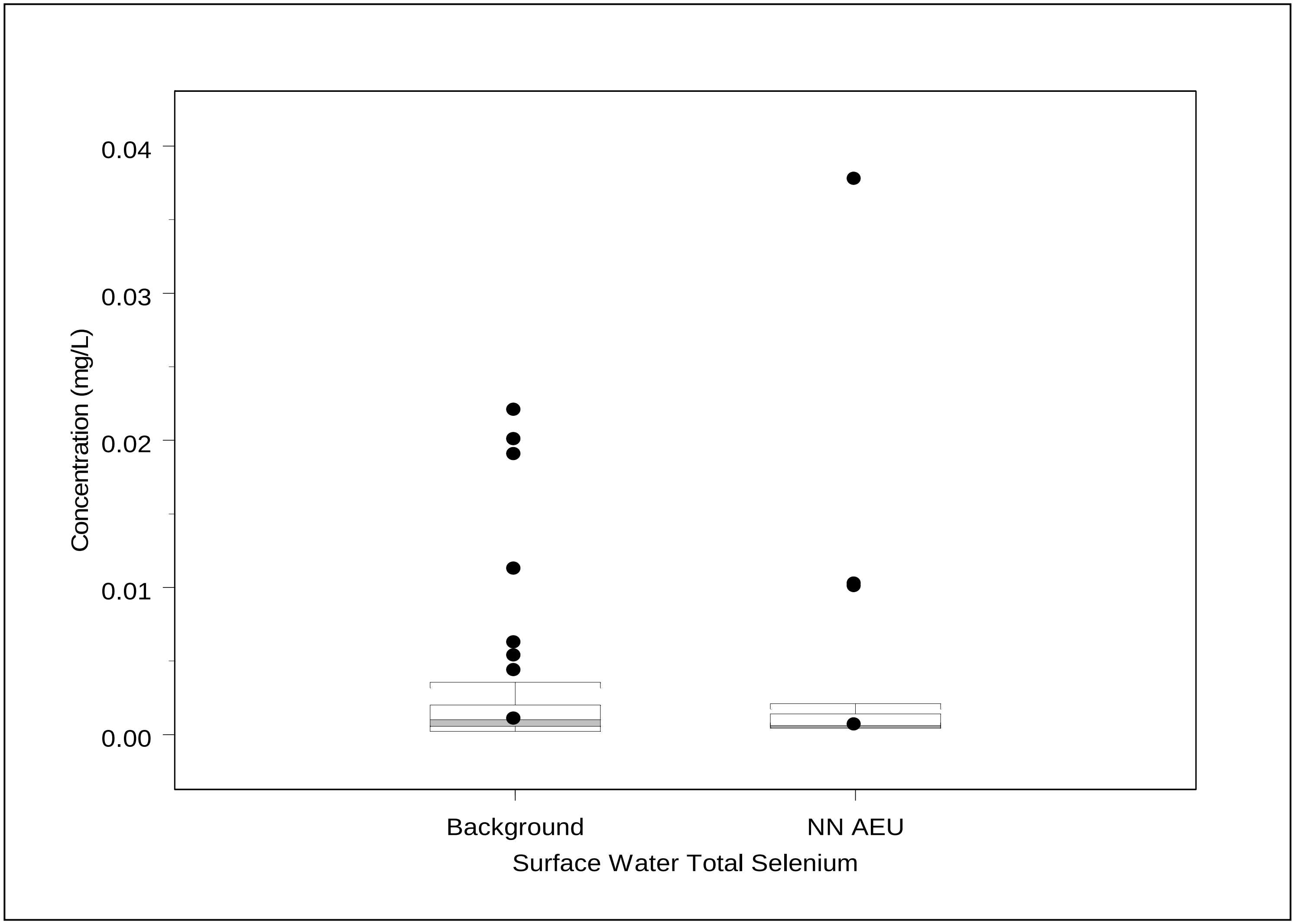
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.9
NN AEU Surface Water Total Box Plots for Lithium



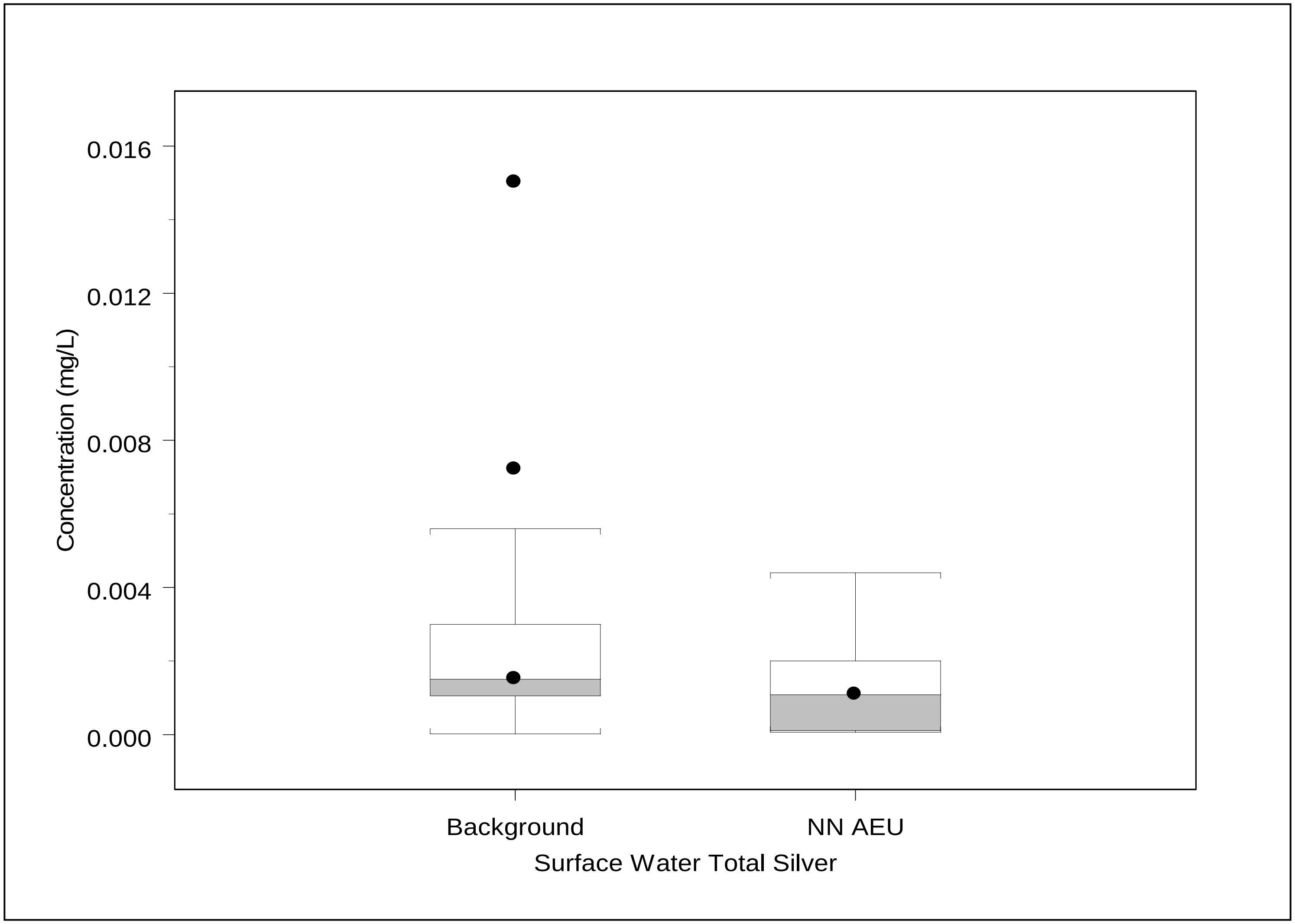
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.10
NN AEU Surface Water Total Box Plots for Selenium



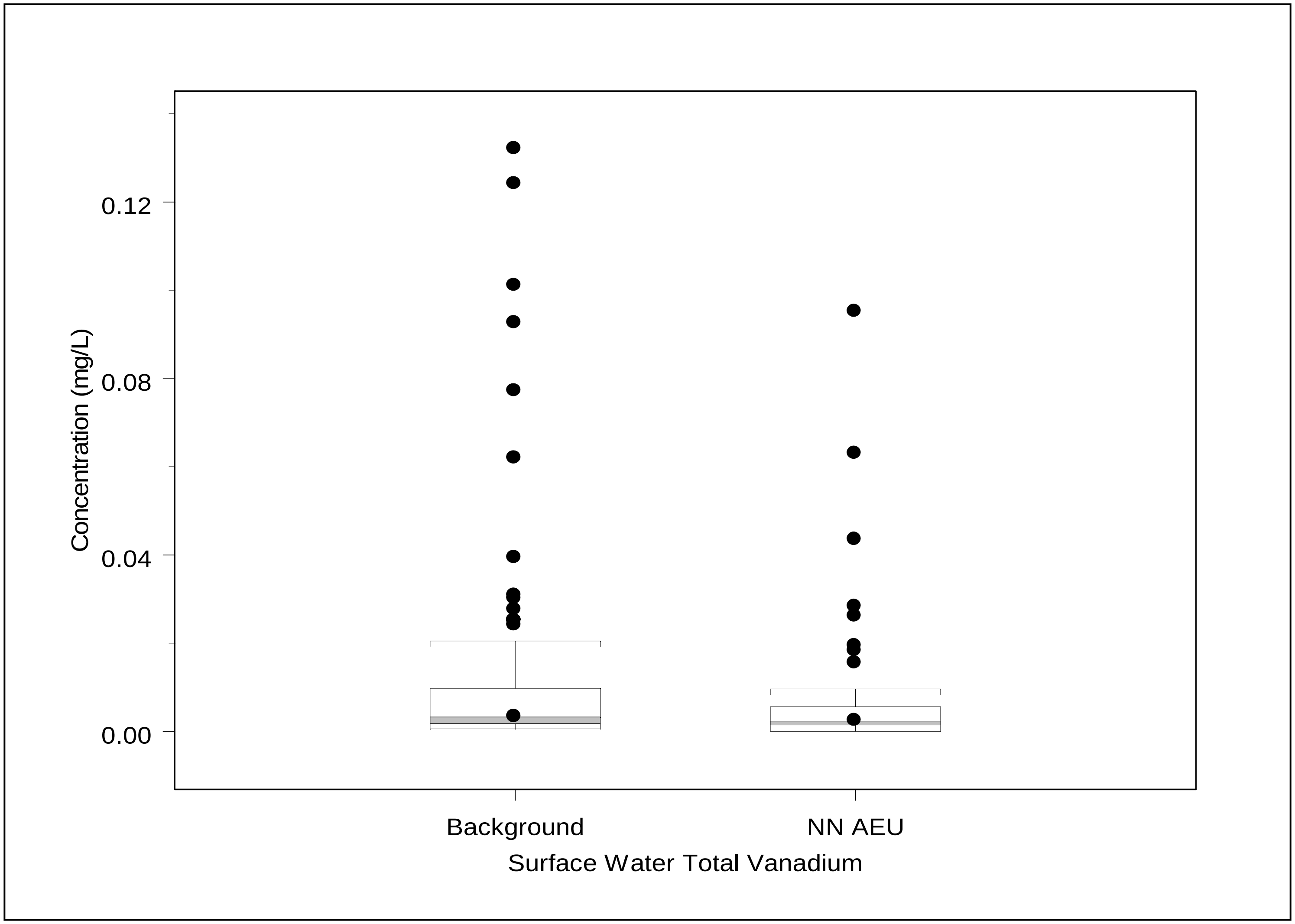
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.11
NN AEU Surface Water Total Box Plots for Silver



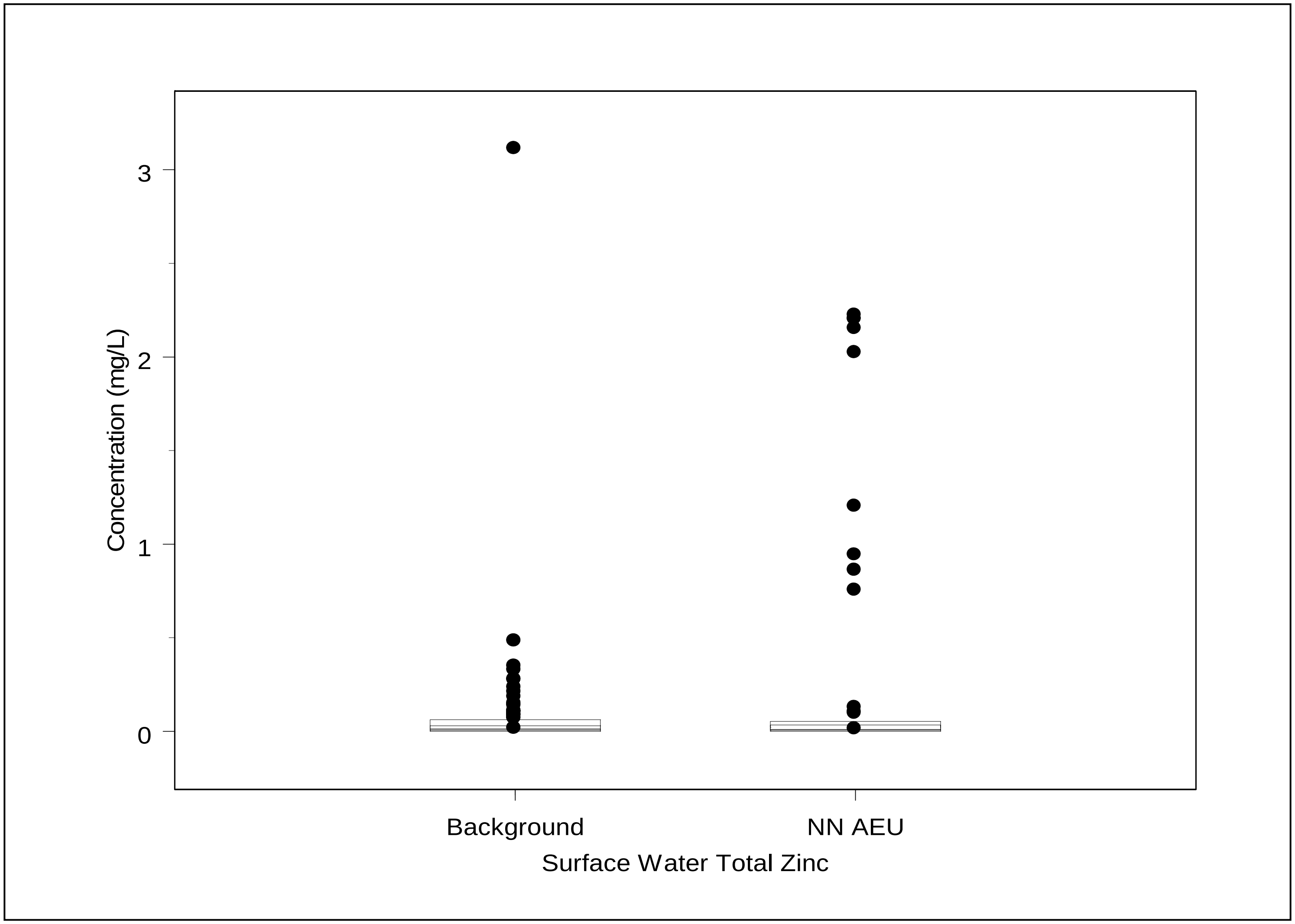
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.12
NN AEU Surface Water Total Box Plots for Vanadium



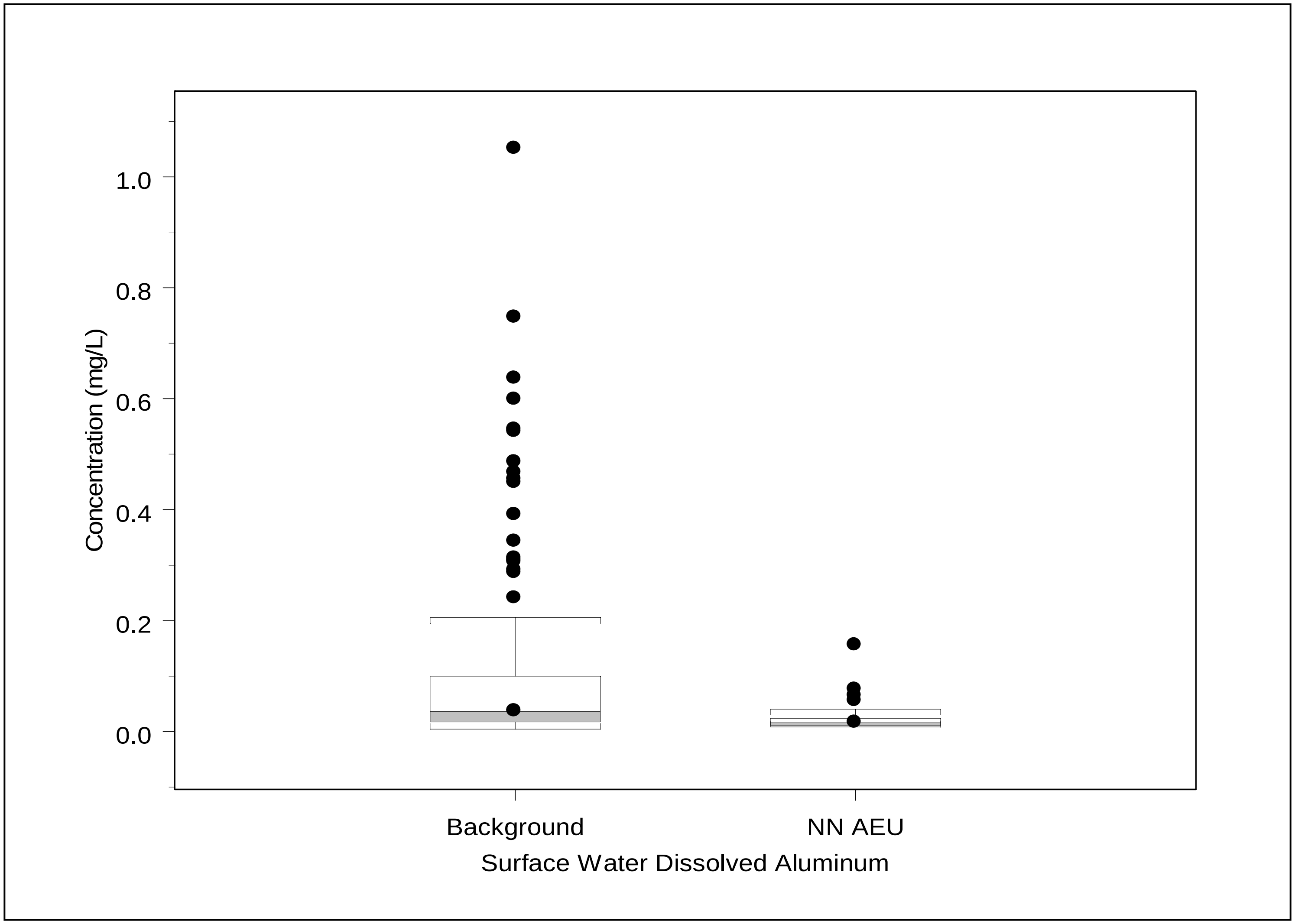
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.13
NN AEU Surface Water Total Box Plots for Zinc



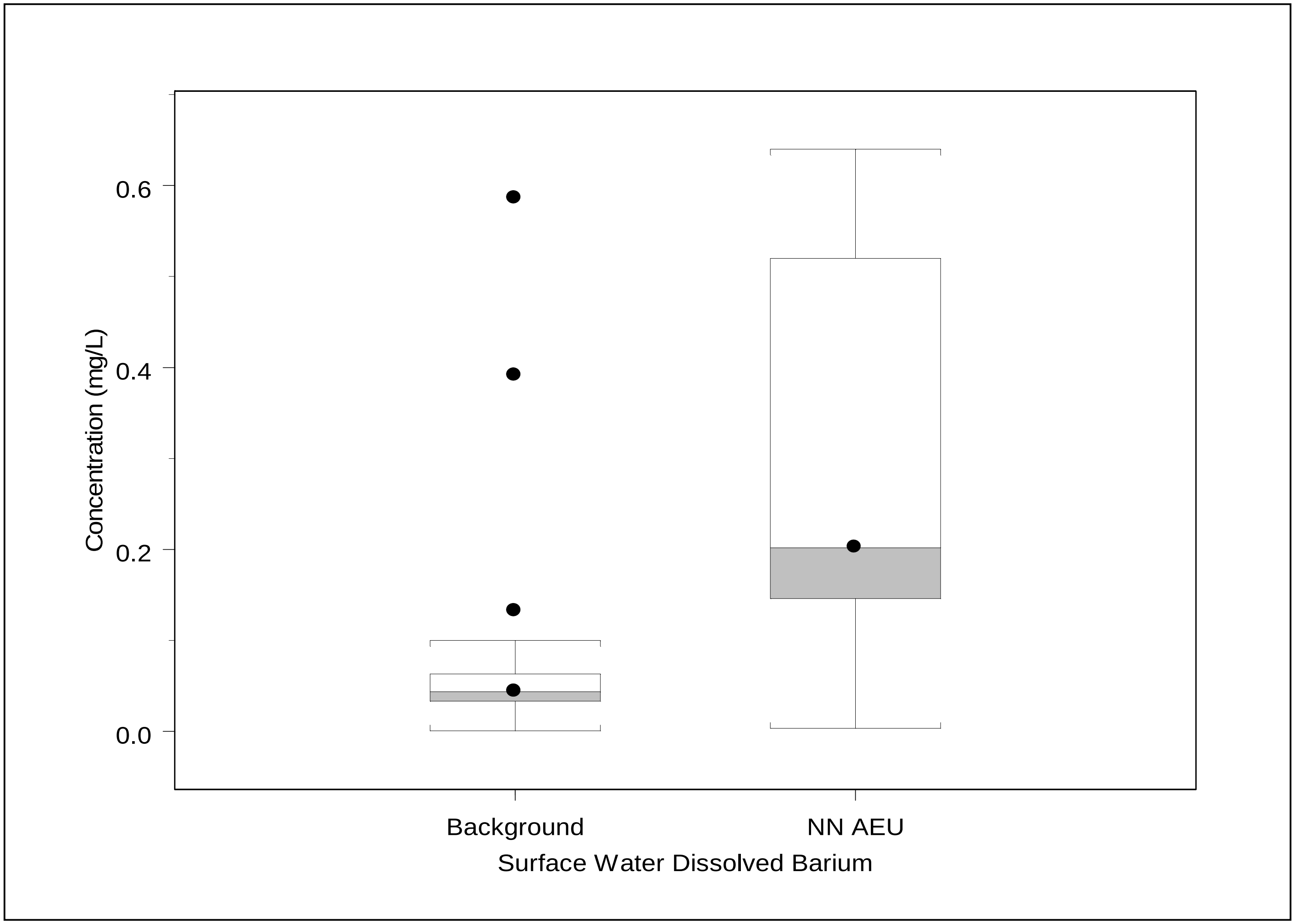
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.14
NN AEU Surface Water Dissolved Box Plots for Aluminum



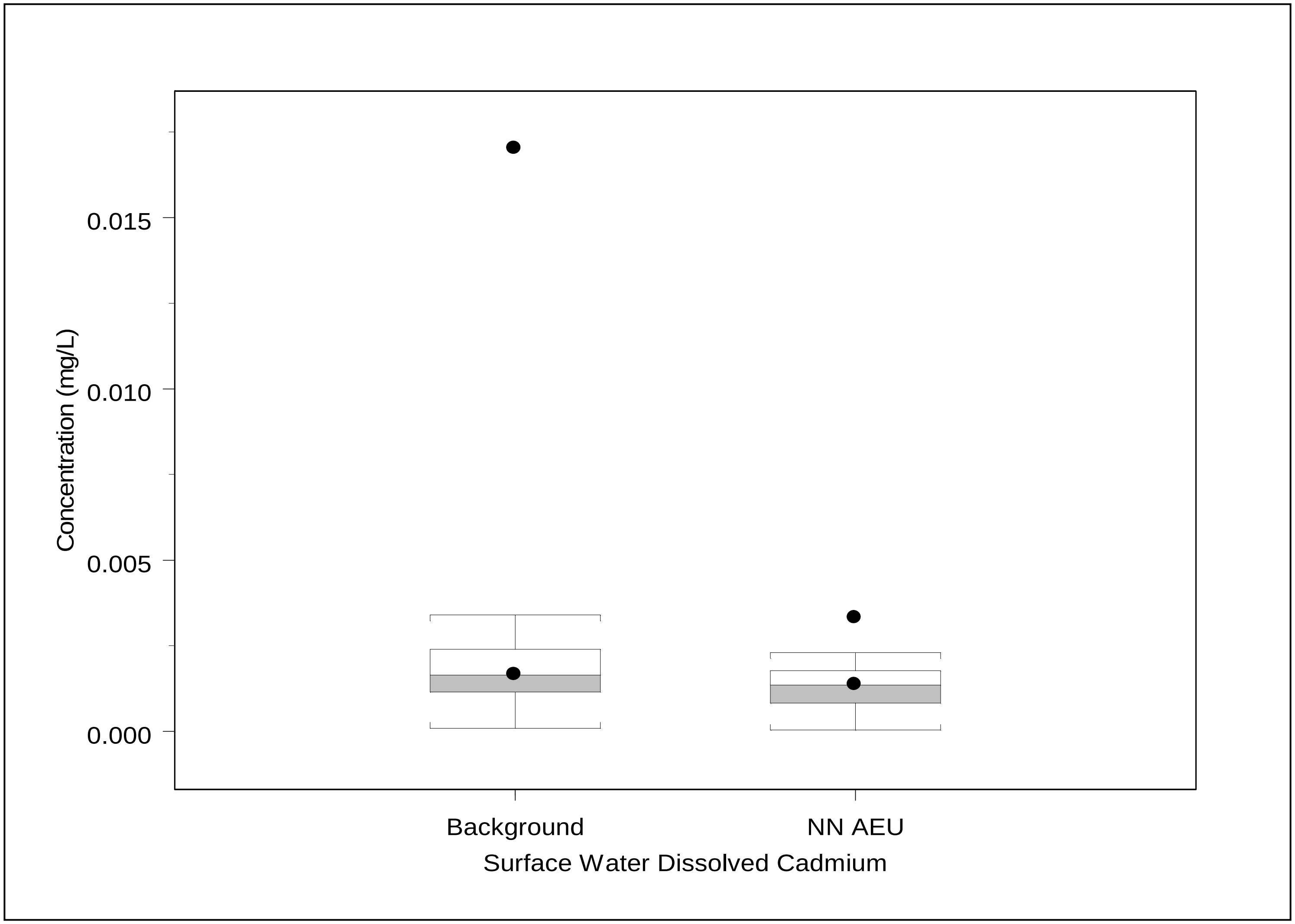
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.15
NN AEU Surface Water Dissolved Box Plots for Barium



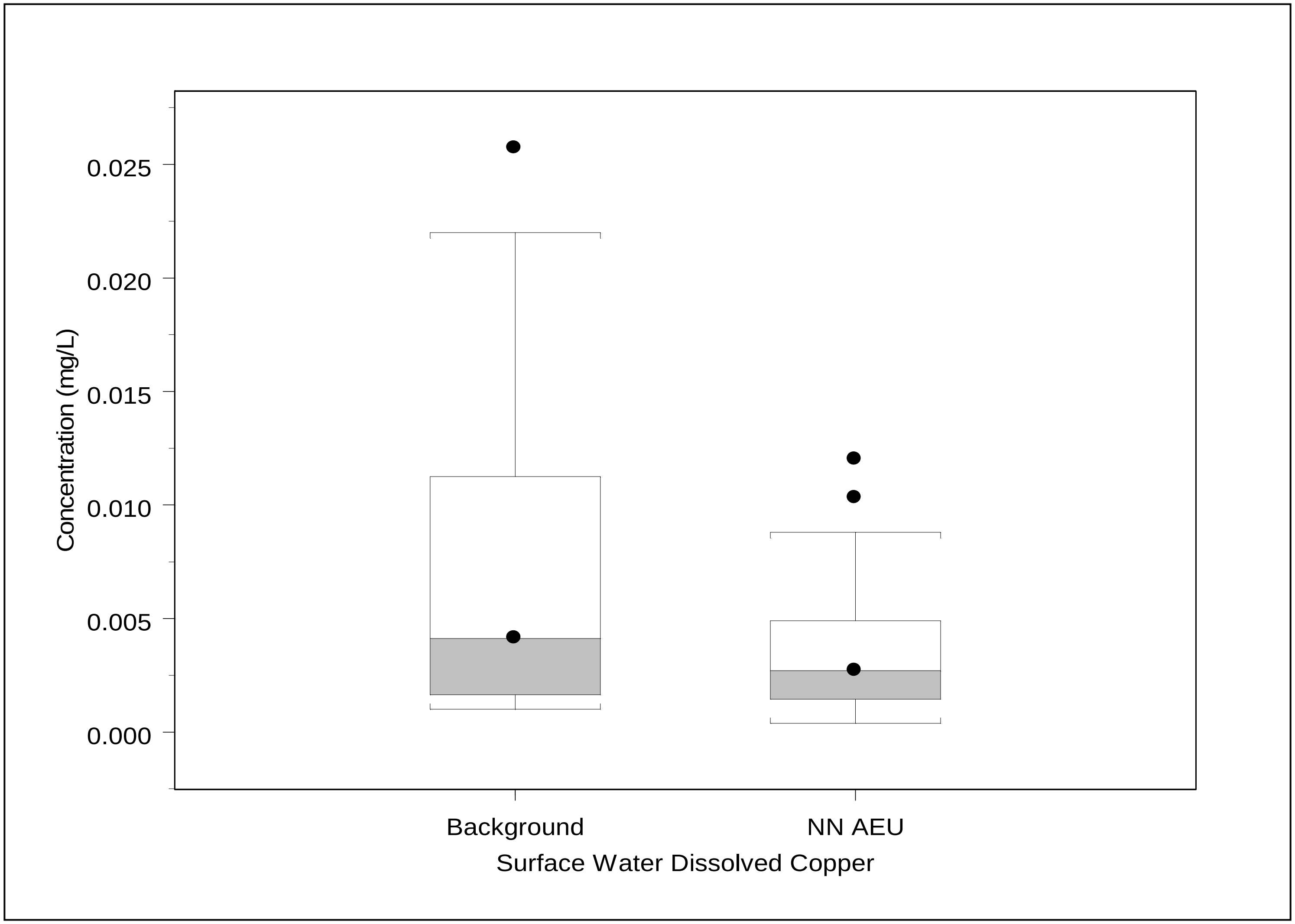
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.16
NN AEU Surface Water Dissolved Box Plots for Cadmium



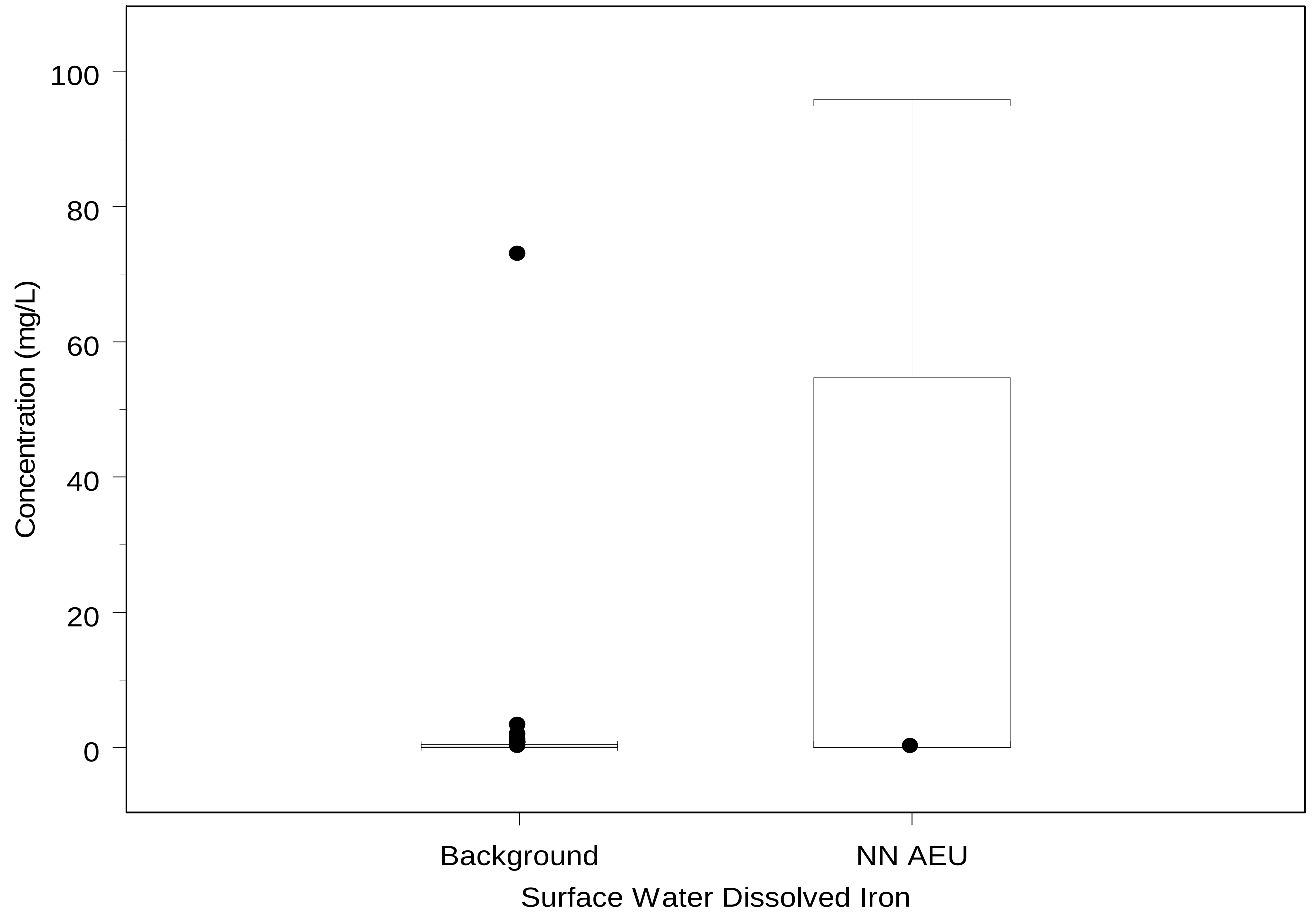
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.17
NN AEU Surface Water Dissolved Box Plots for Copper



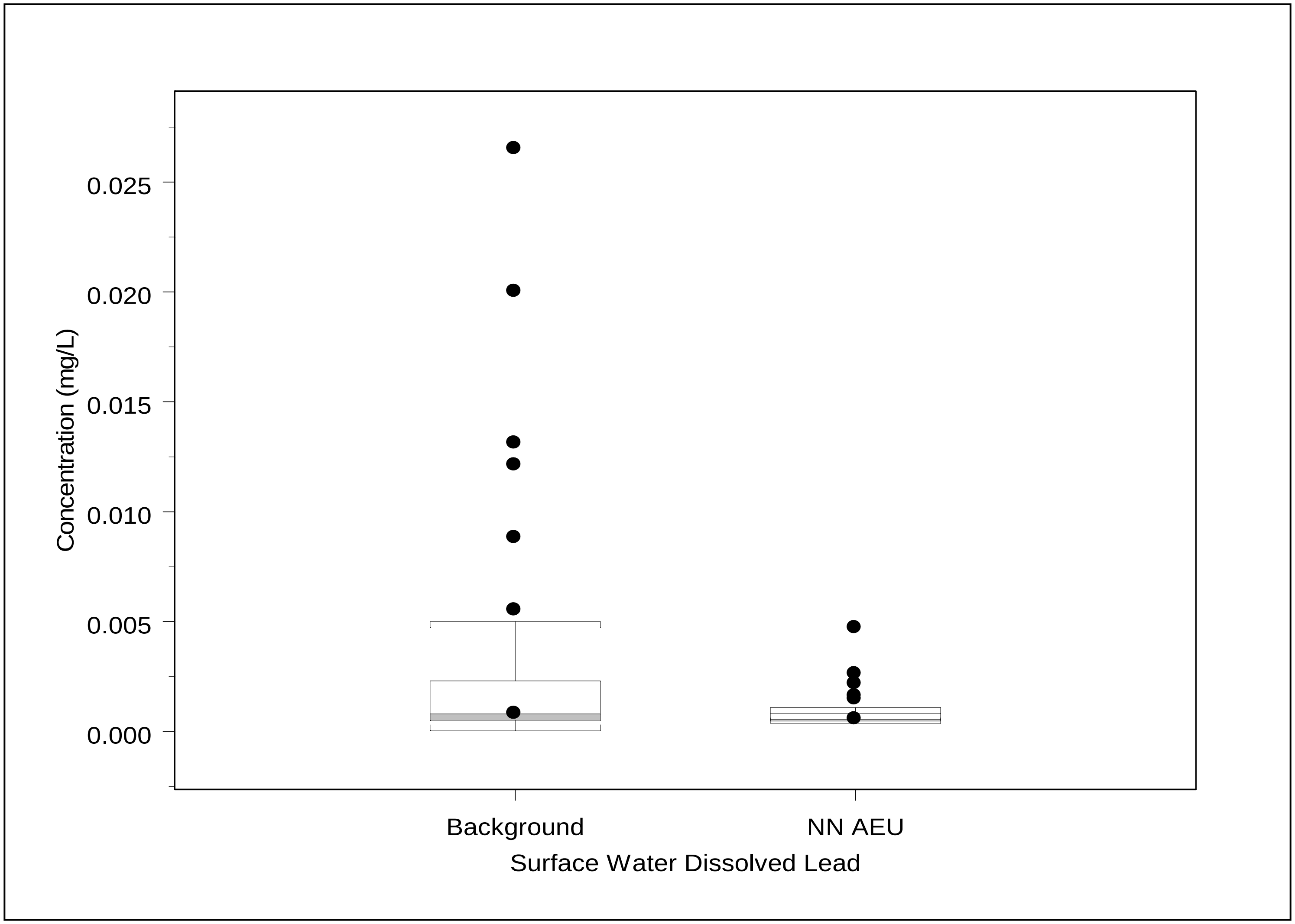
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.18
NN AEU Surface Water Dissolved Box Plots for Iron



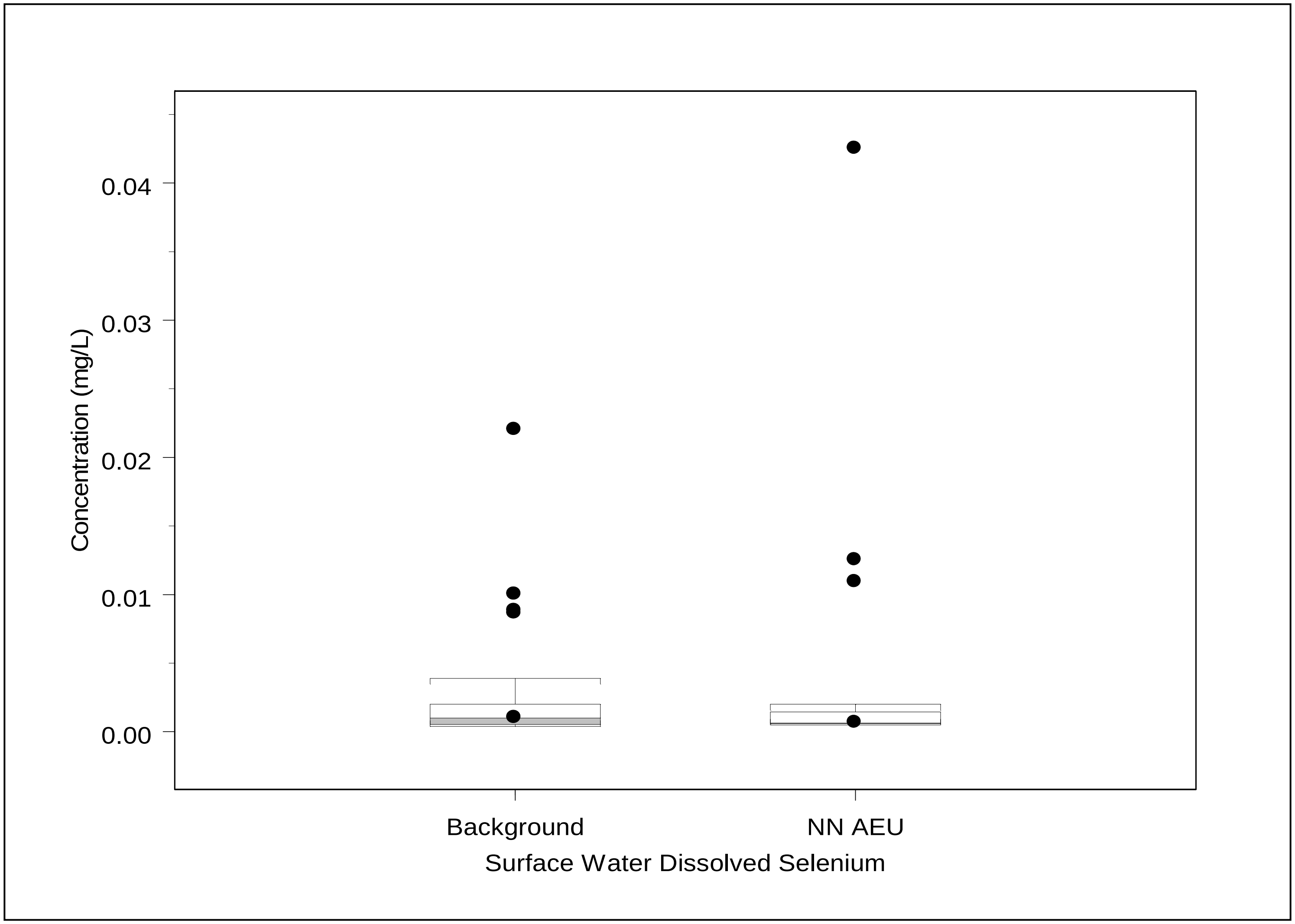
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.19
NN AEU Surface Water Dissolved Box Plots for Lead



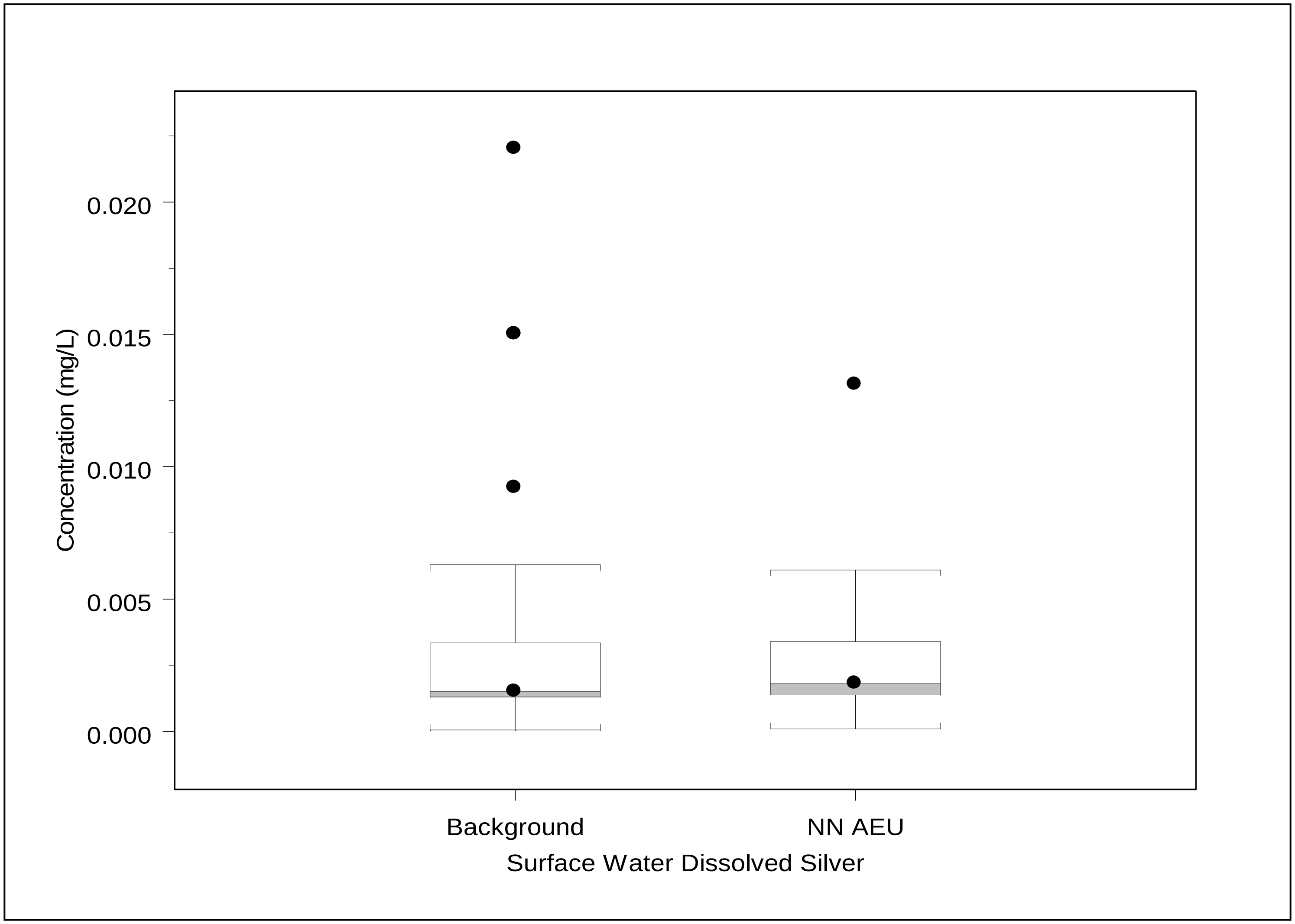
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.20
NN AEU Surface Water Dissolved Box Plots for Selenium



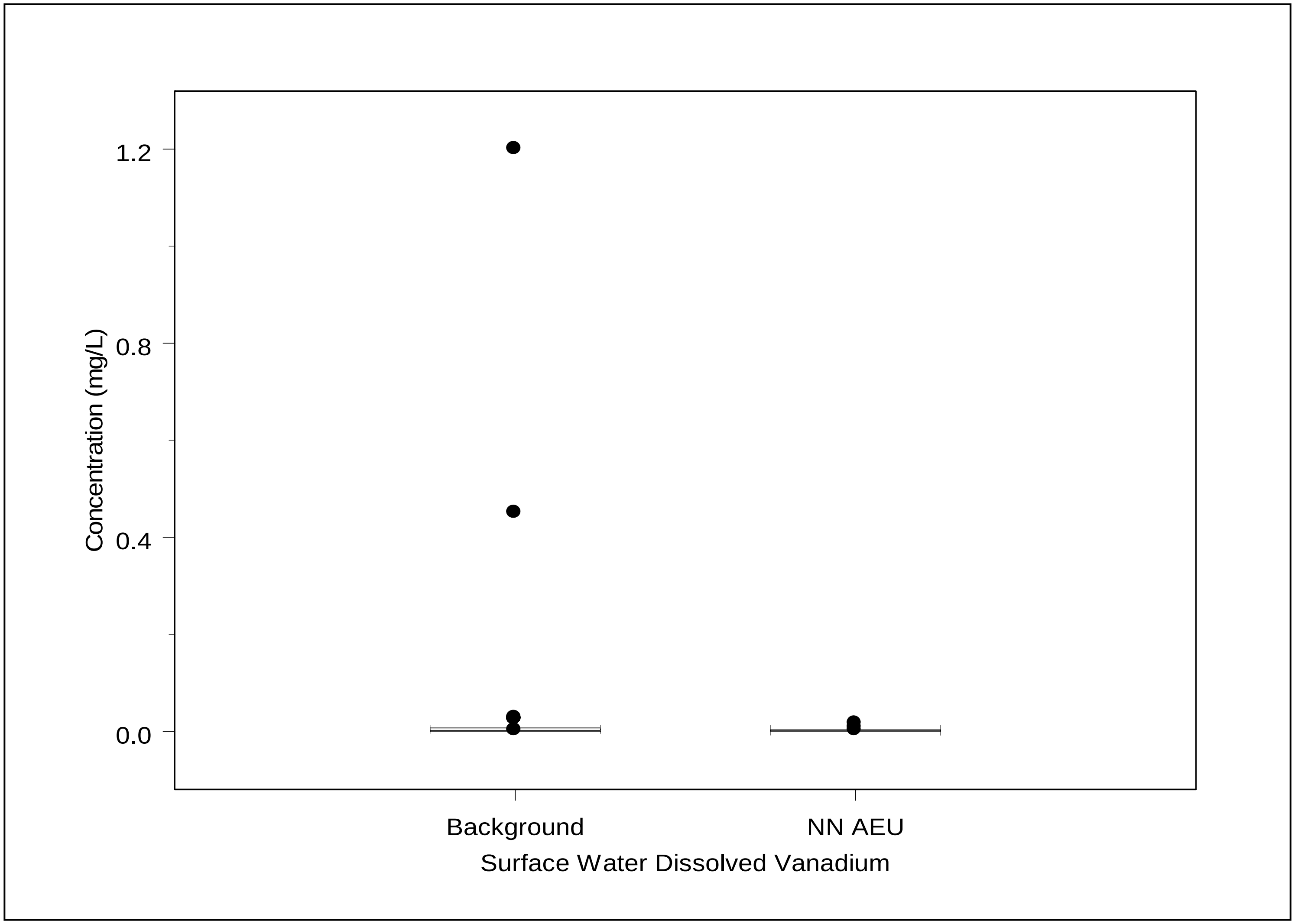
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.21
NN AEU Surface Water Dissolved Box Plots for Silver



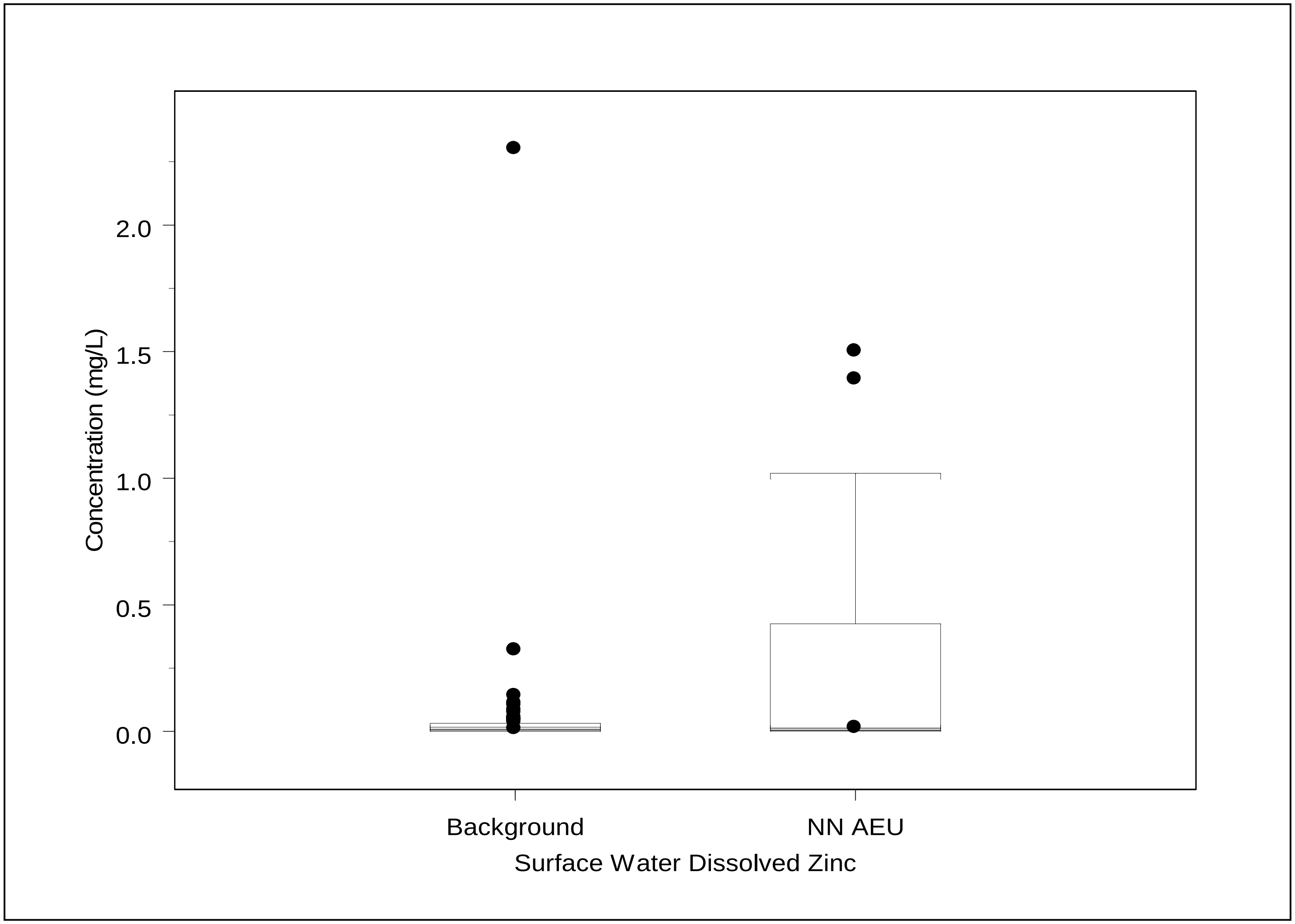
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.22
NN AEU Surface Water Dissolved Box Plots for Vanadium



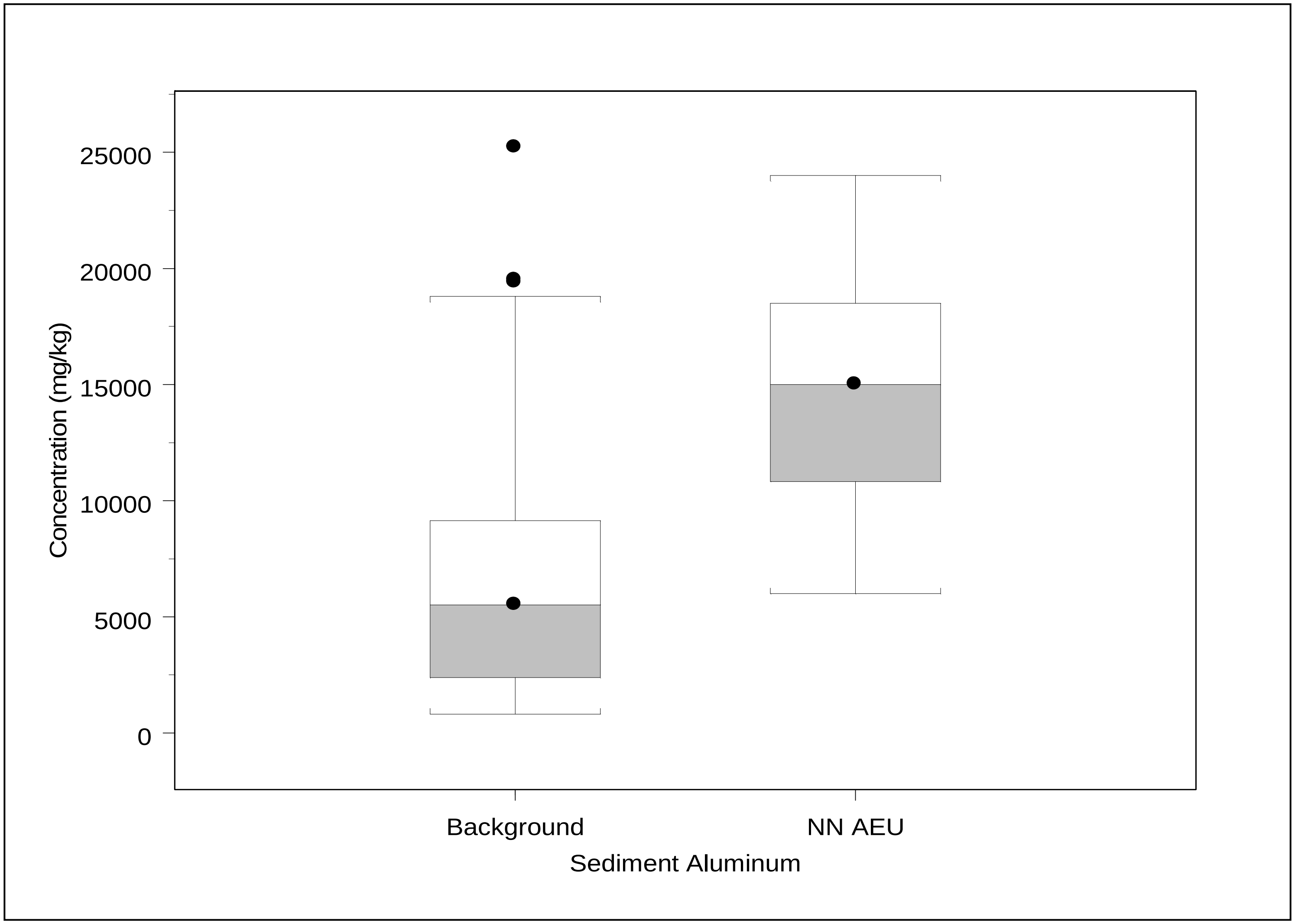
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.23
NN AEU Surface Water Dissolved Box Plots for Zinc



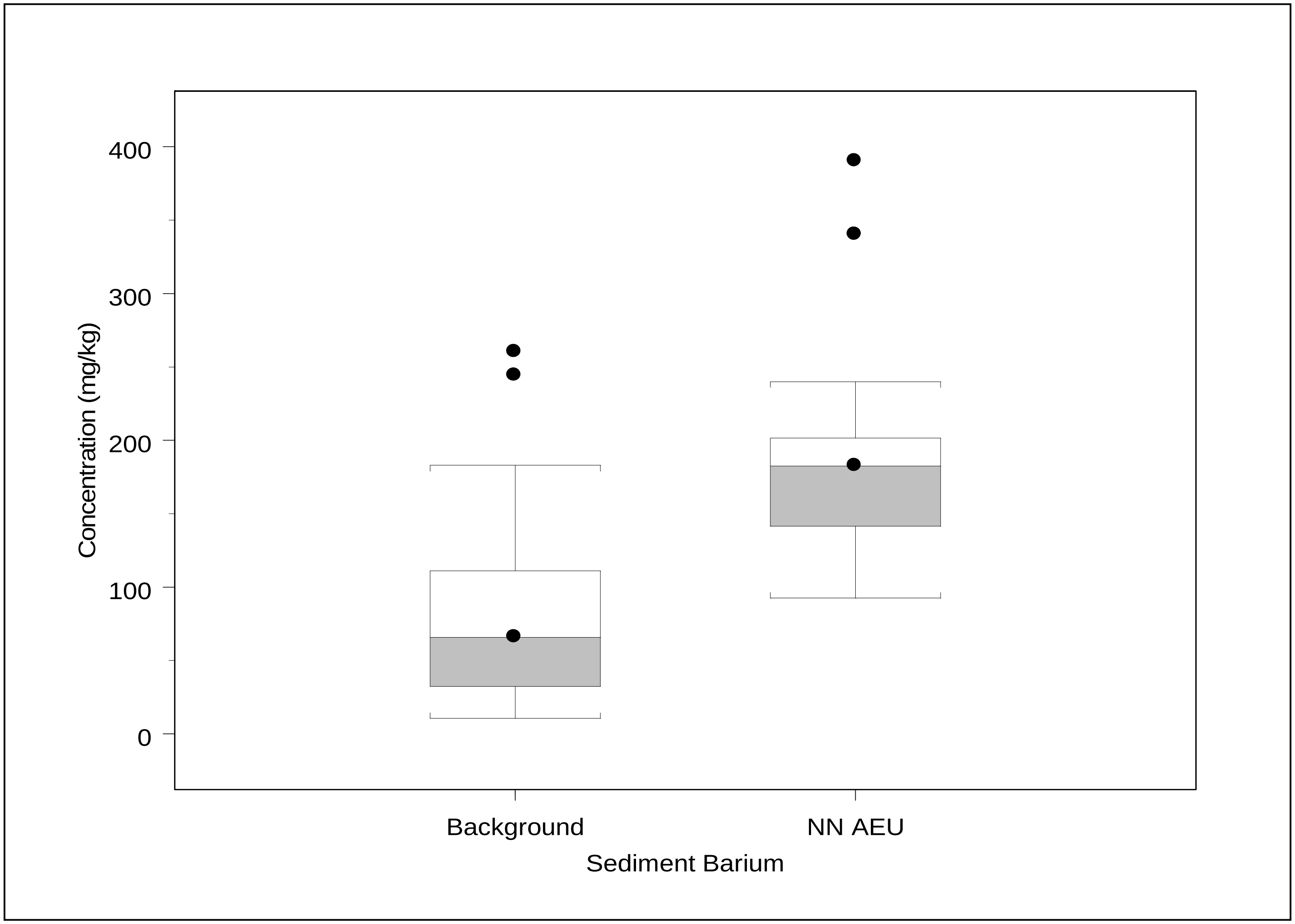
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.24
NN AEU Sediment Box Plots for Aluminum



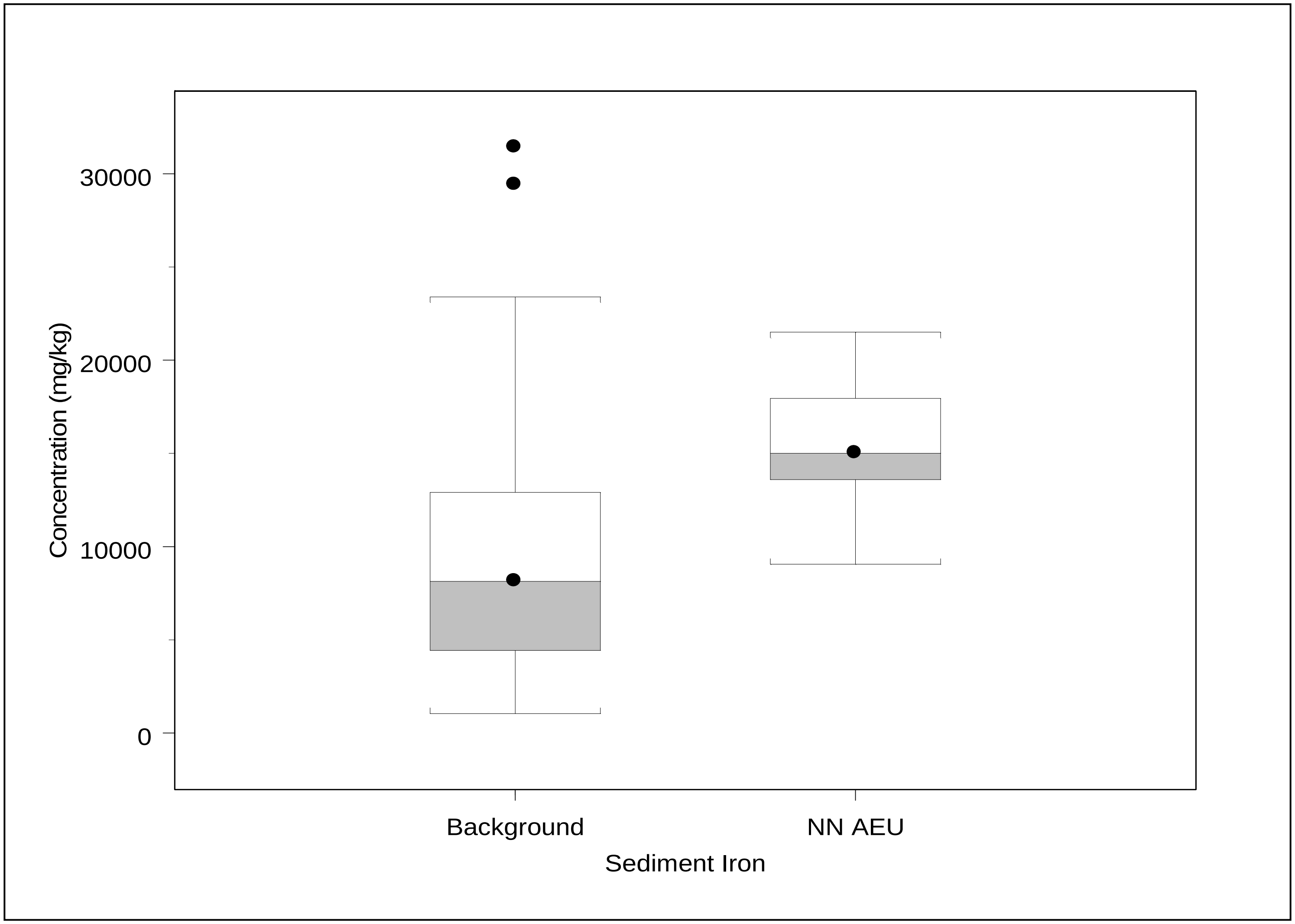
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.25
NN AEU Sediment Box Plots for Barium



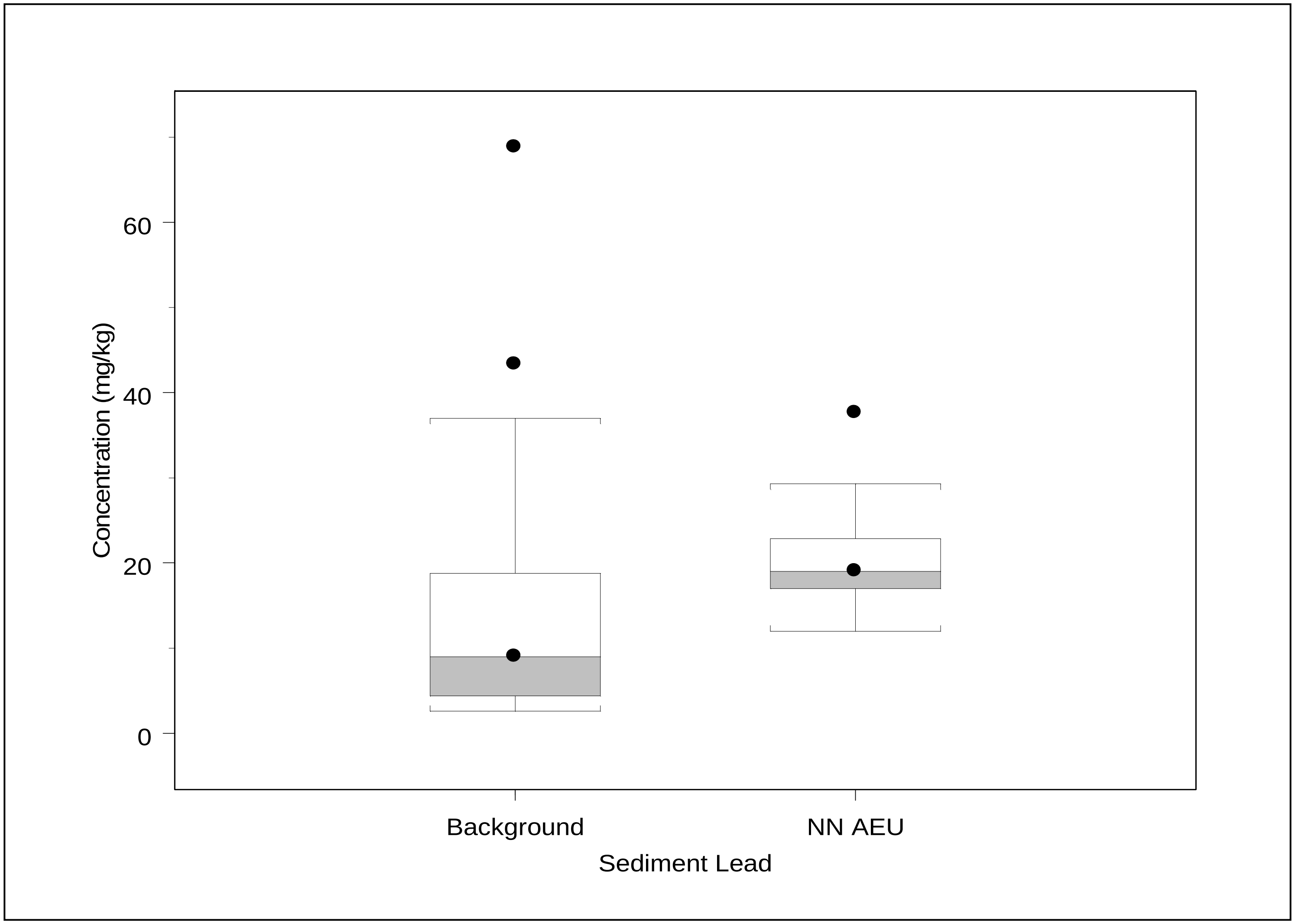
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.26
NN AEU Sediment Box Plots for Iron



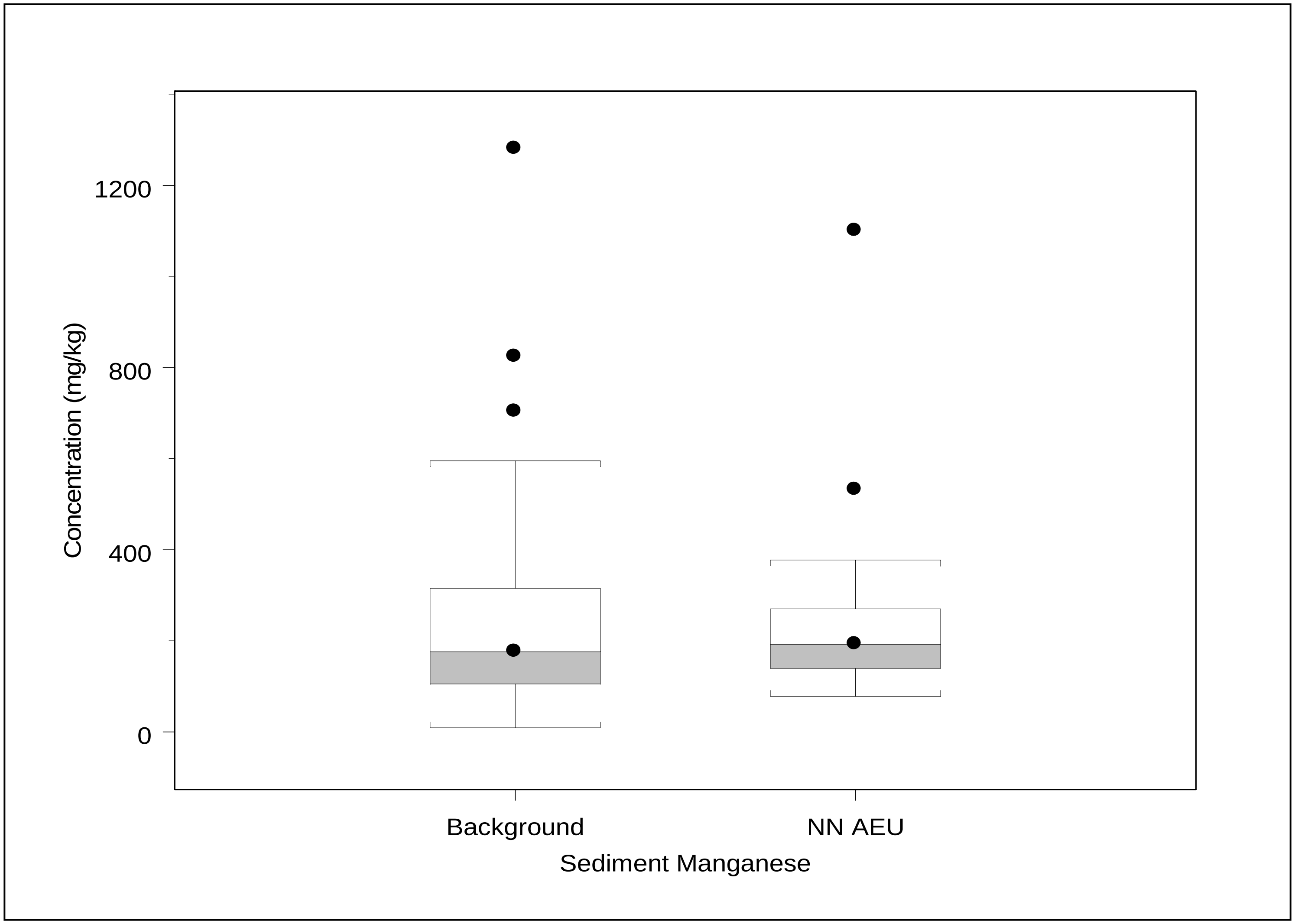
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.27
NN AEU Sediment Box Plots for Lead



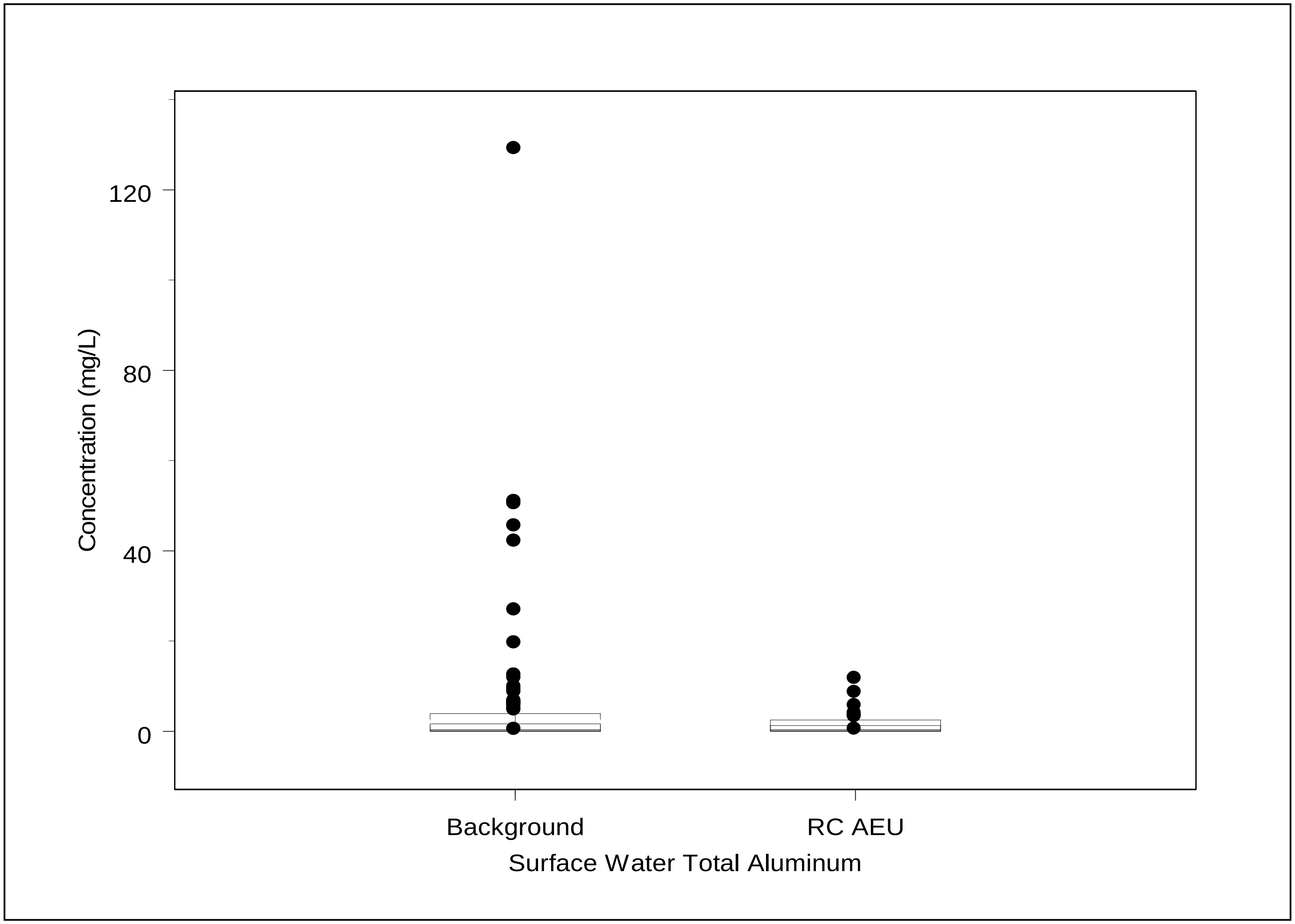
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.NN AEU.28
NN AEU Sediment Box Plots for Manganese



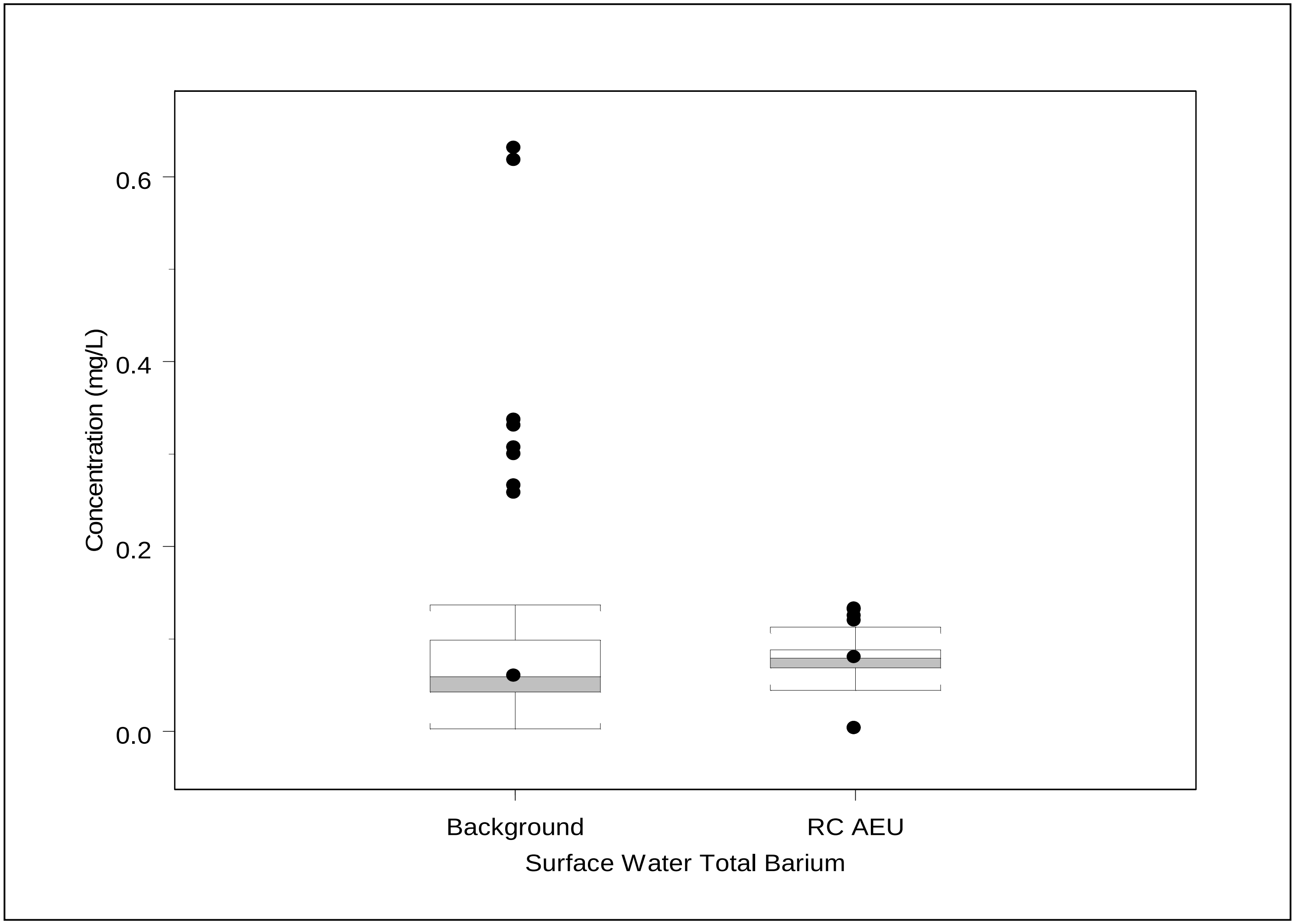
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.1
RC AEU Surface Water Total Box Plots for Aluminum



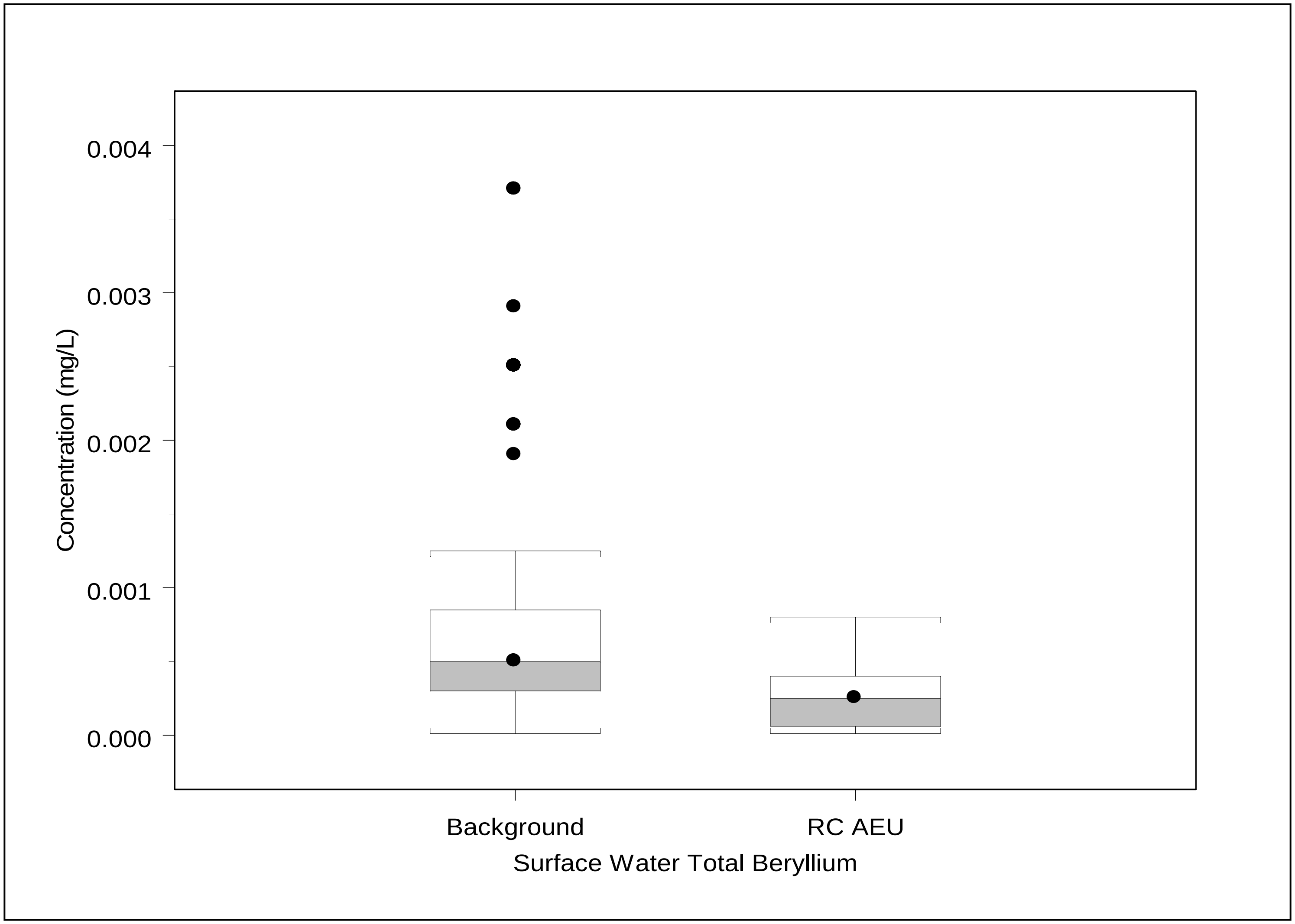
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.2
RC AEU Surface Water Total Box Plots for Barium



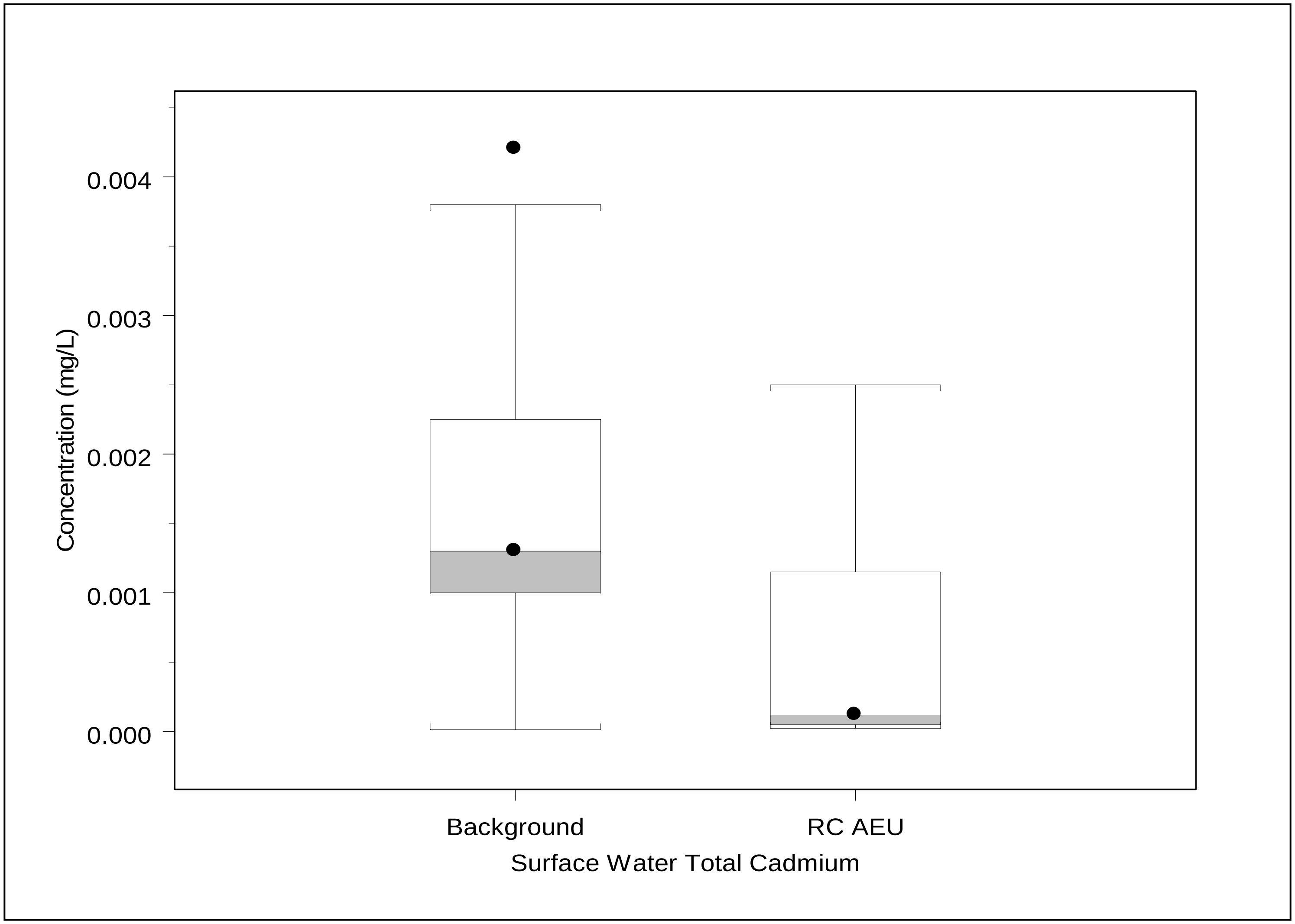
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.3
RC AEU Surface Water Total Box Plots for Beryllium



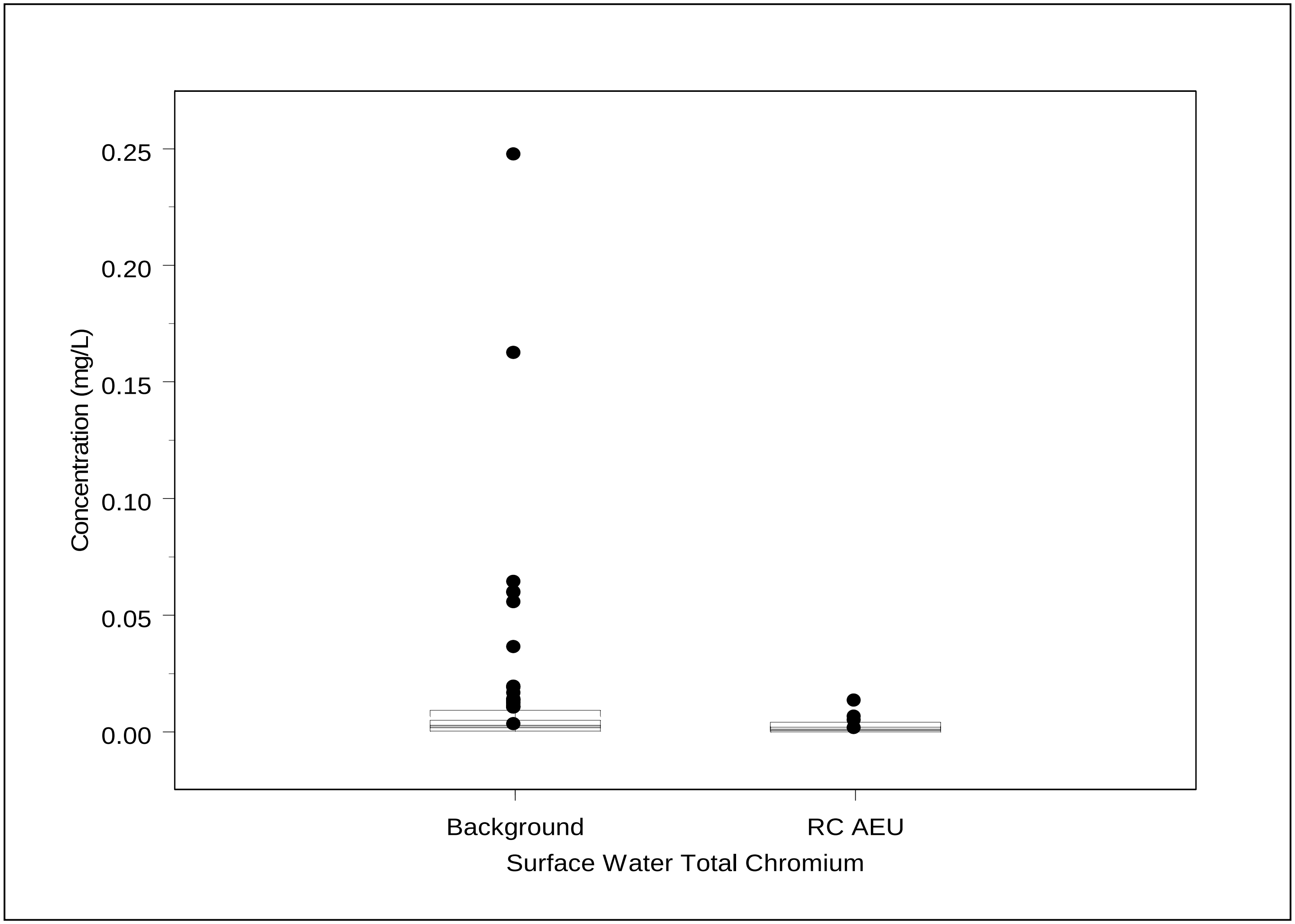
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.4
RC AEU Surface Water Total Box Plots for Cadmium



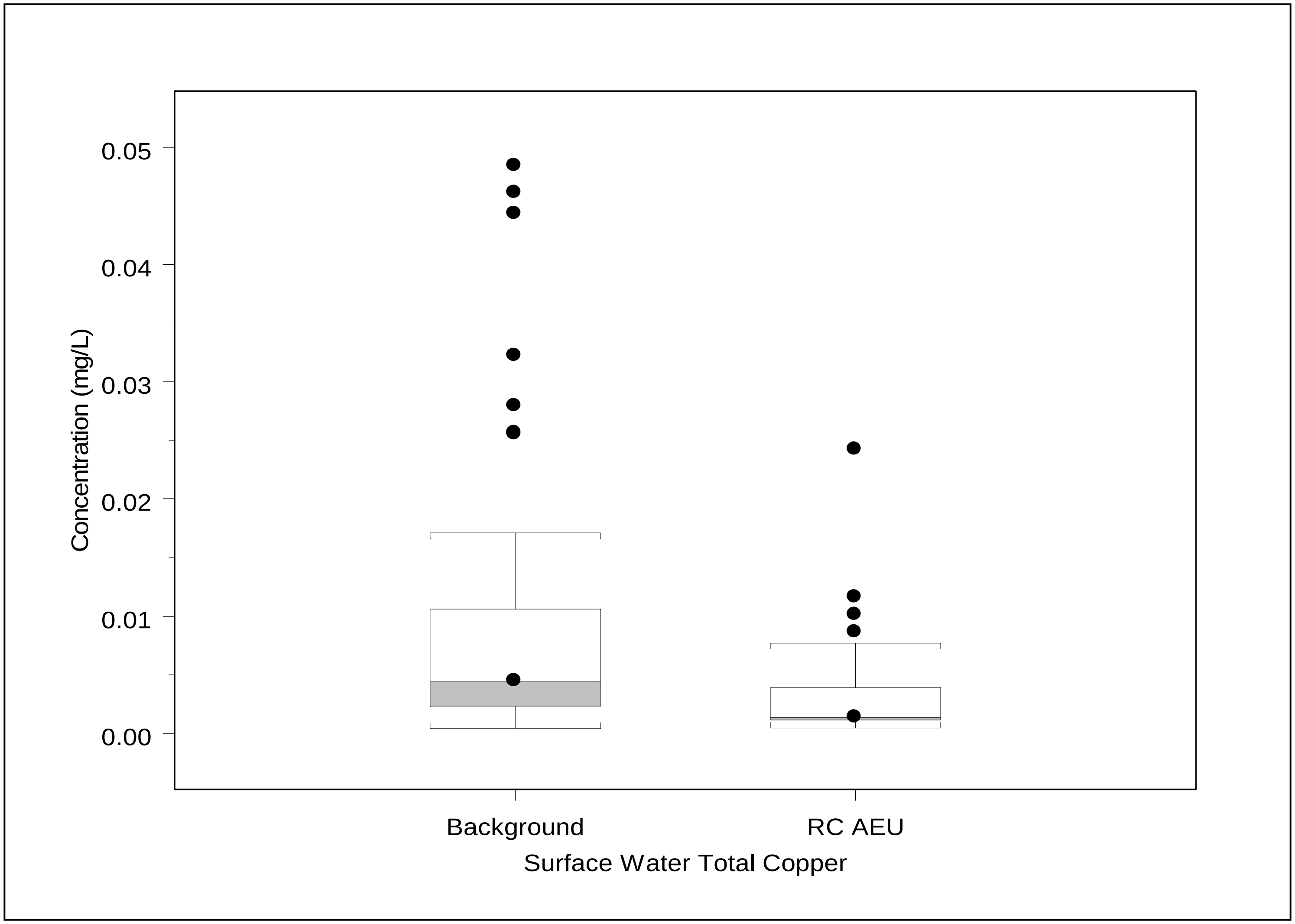
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.5
RC AEU Surface Water Total Box Plots for Chromium



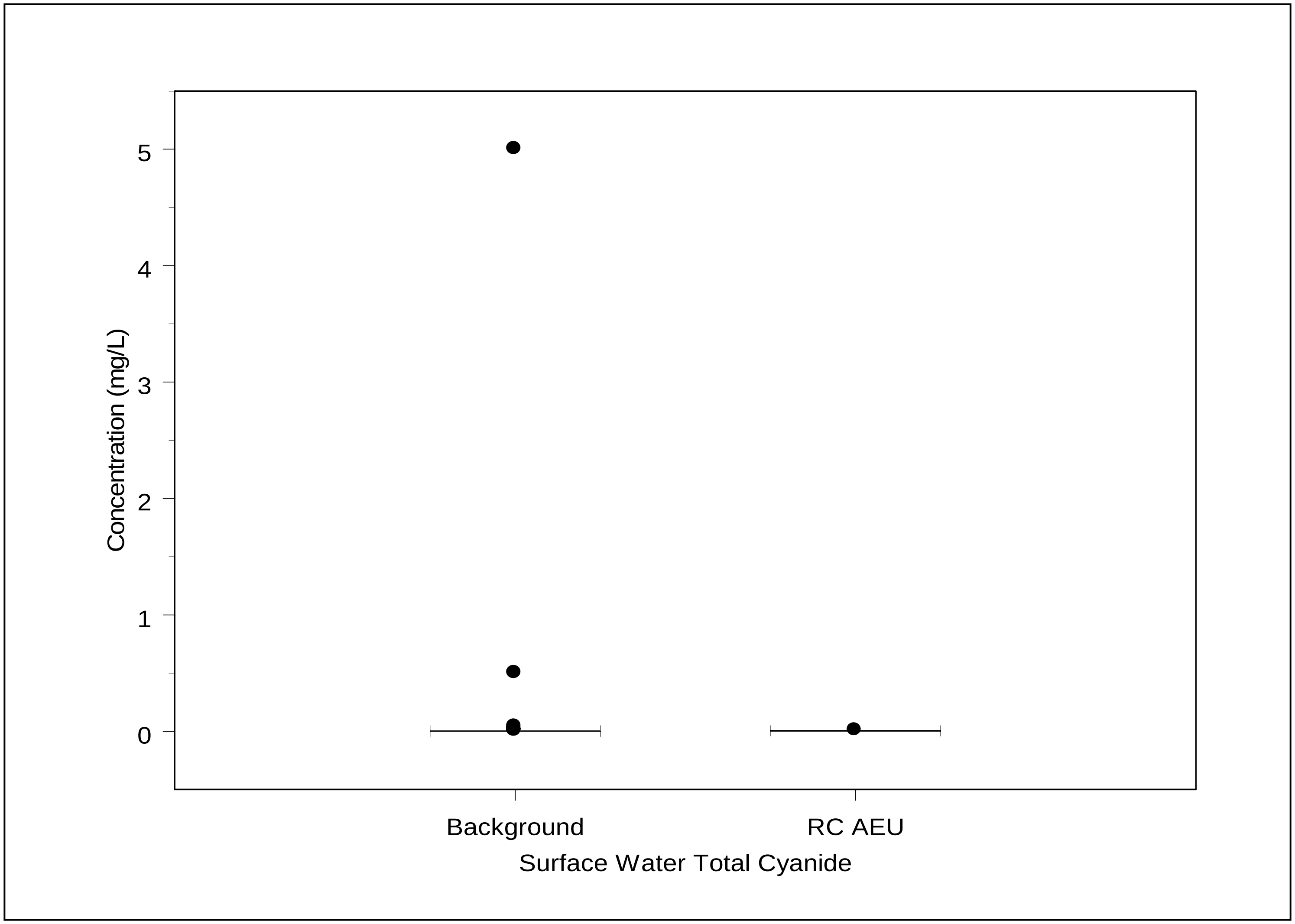
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.6
RC AEU Surface Water Total Box Plots for Copper



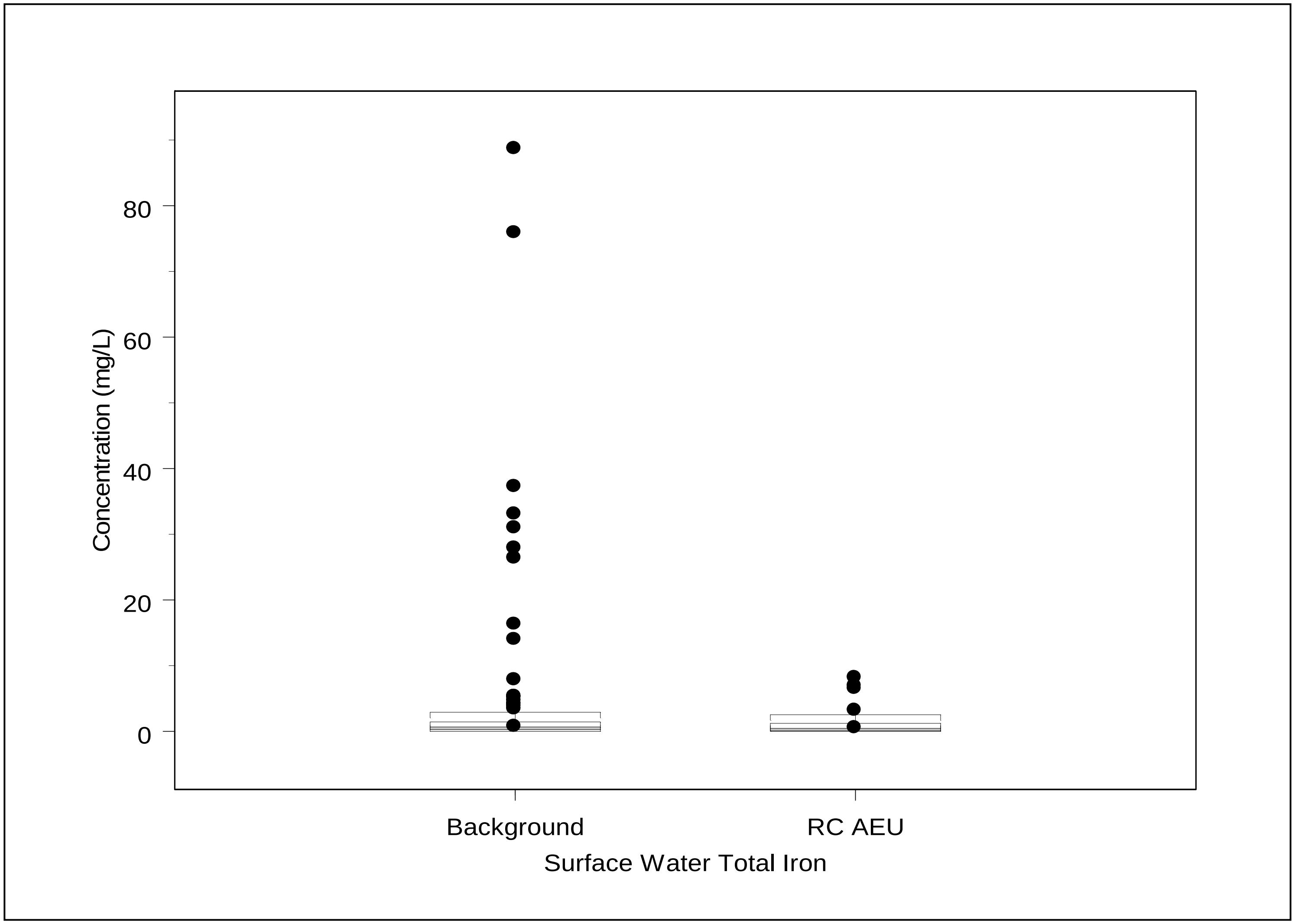
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.7
RC AEU Surface Water Total Box Plots for Cyanide



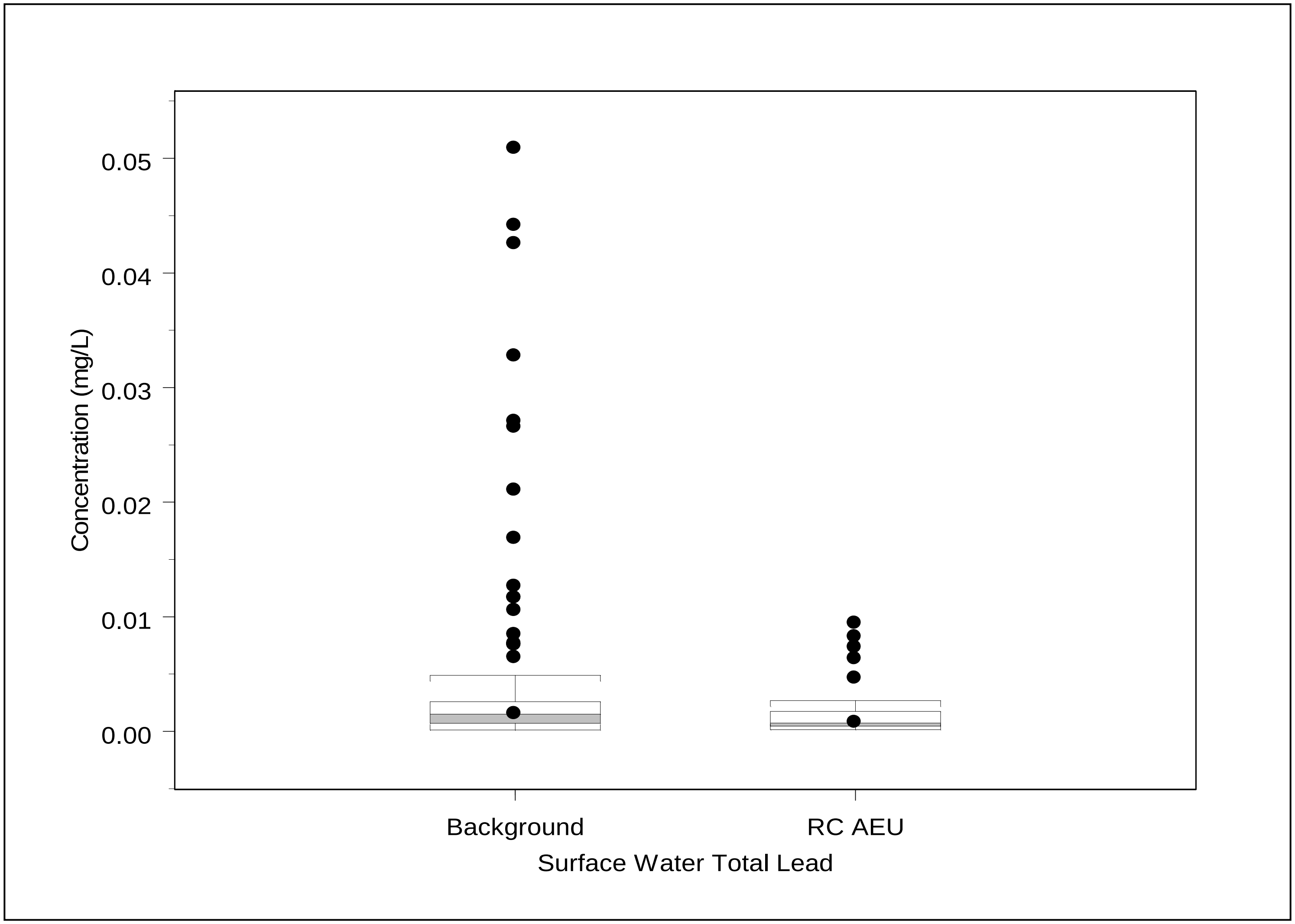
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.8
RC AEU Surface Water Total Box Plots for Iron



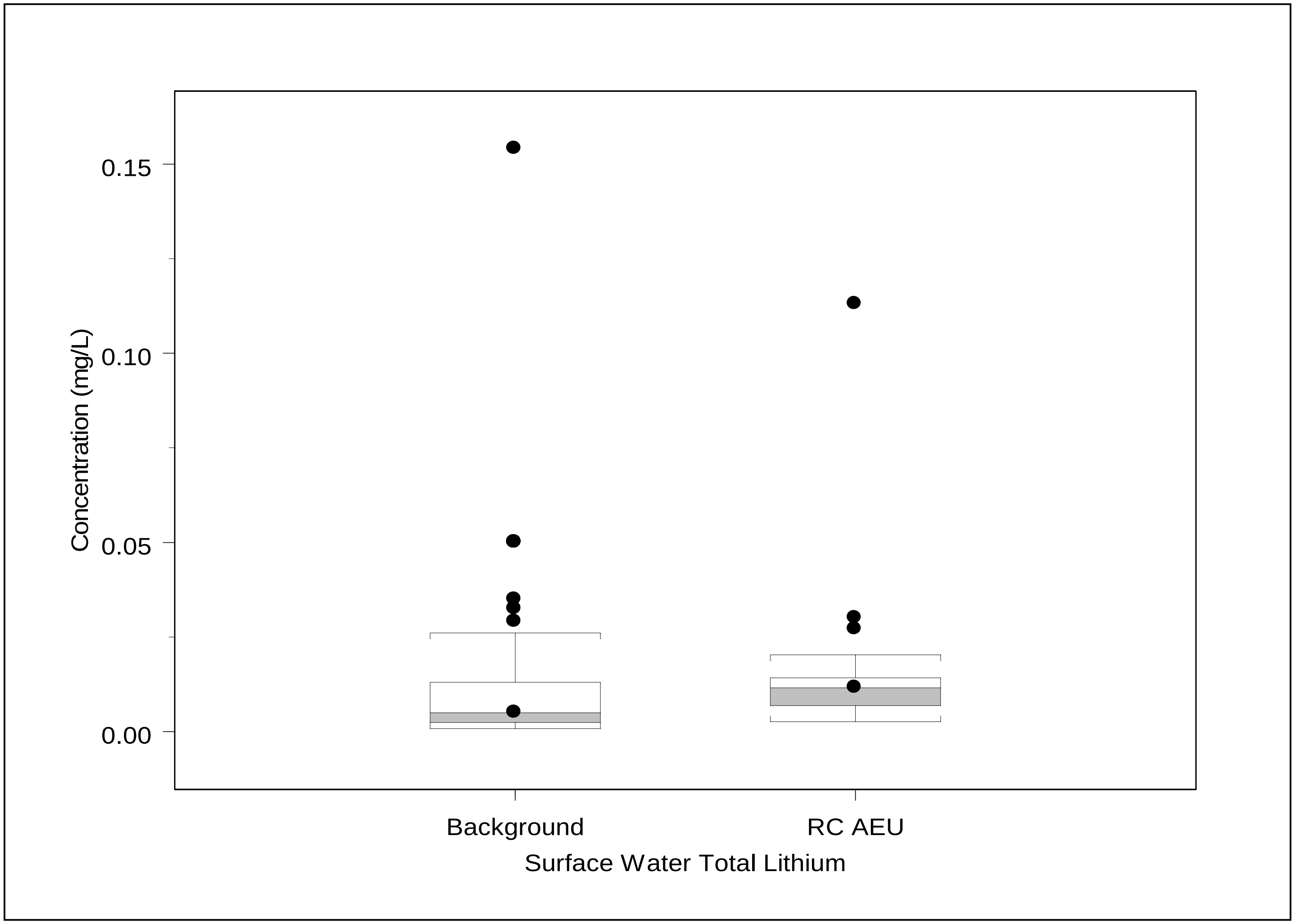
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.9
RC AEU Surface Water Total Box Plots for Lead



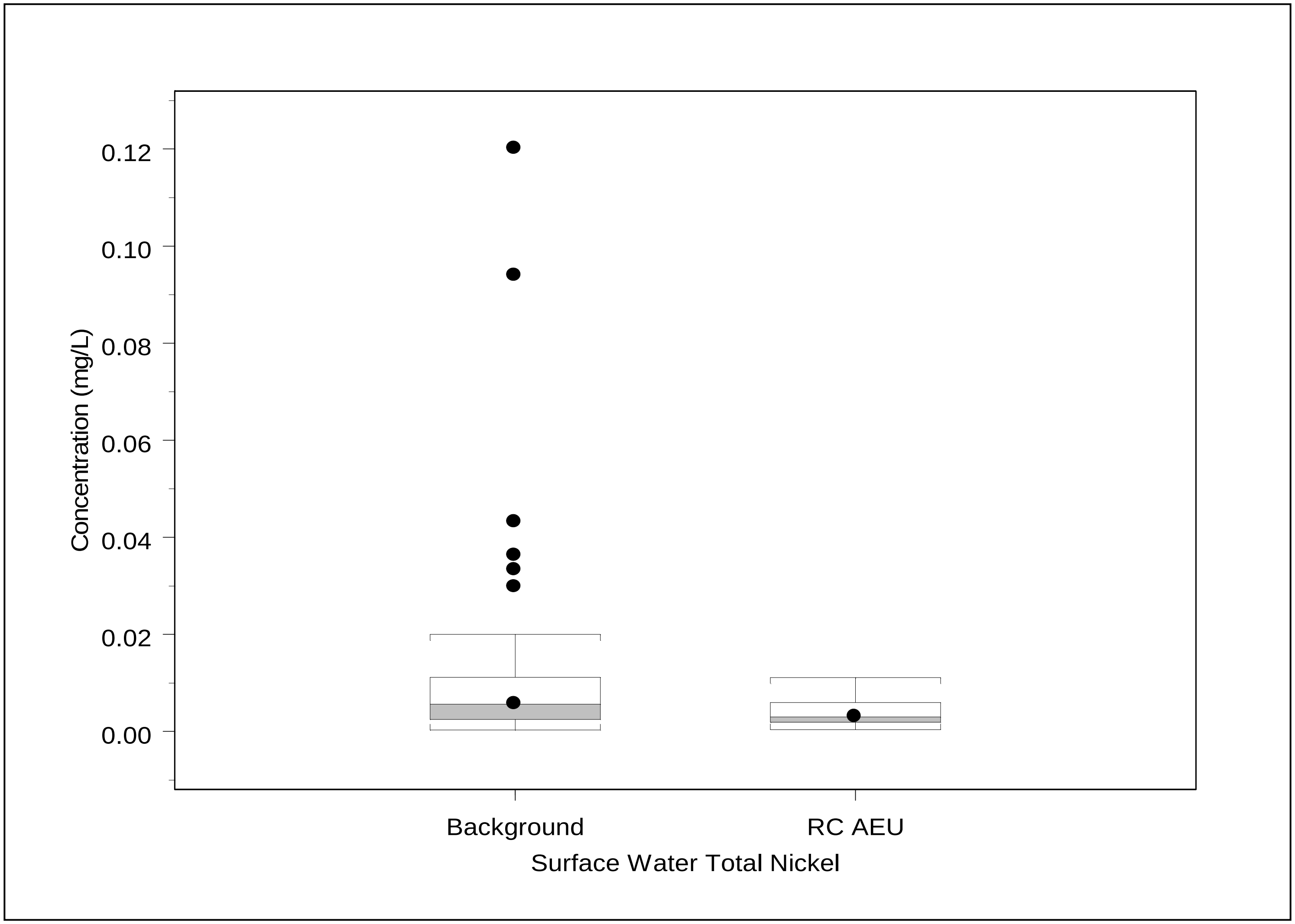
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.10
RC AEU Surface Water Total Box Plots for Lithium



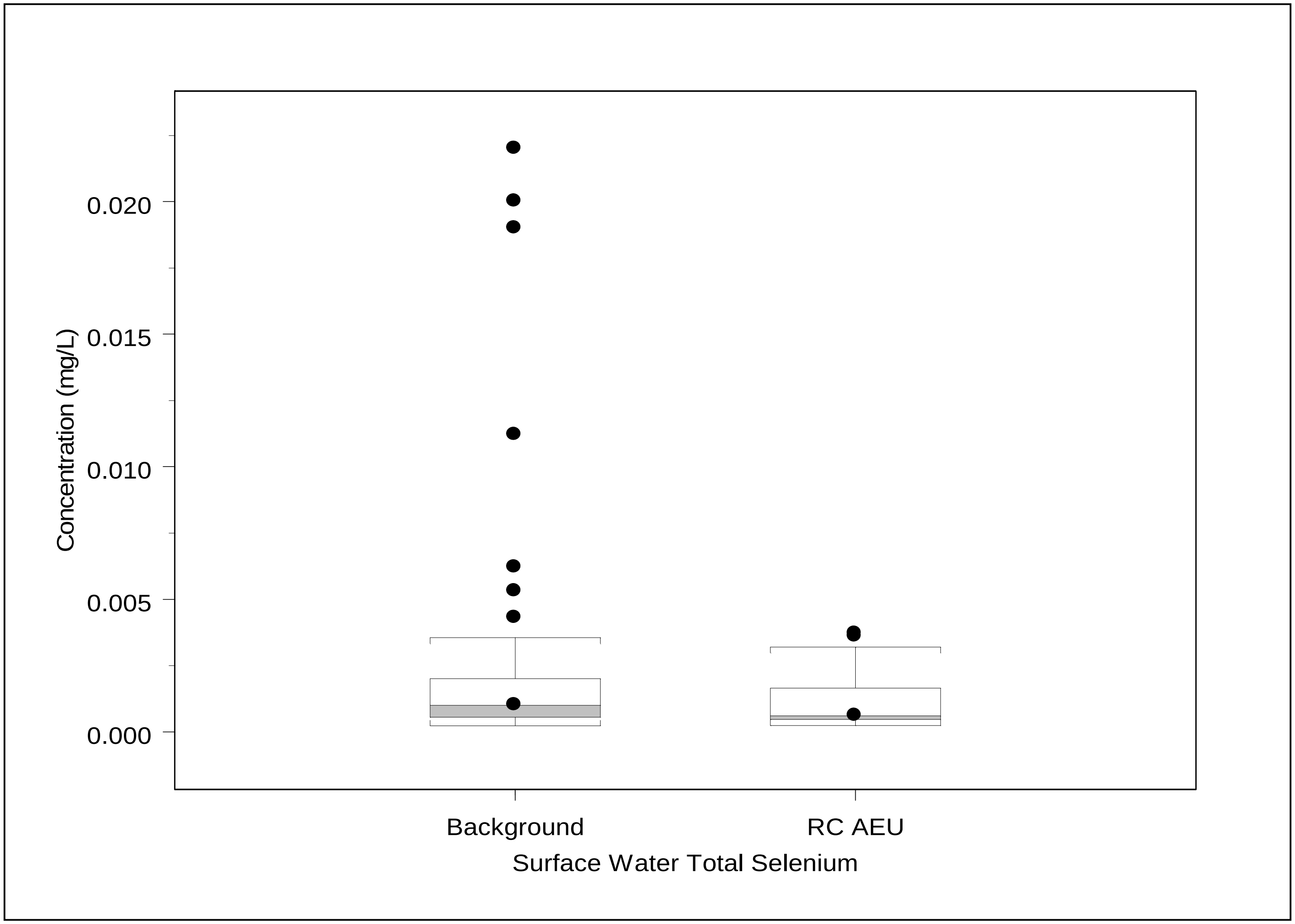
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.11
RC AEU Surface Water Total Box Plots for Nickel



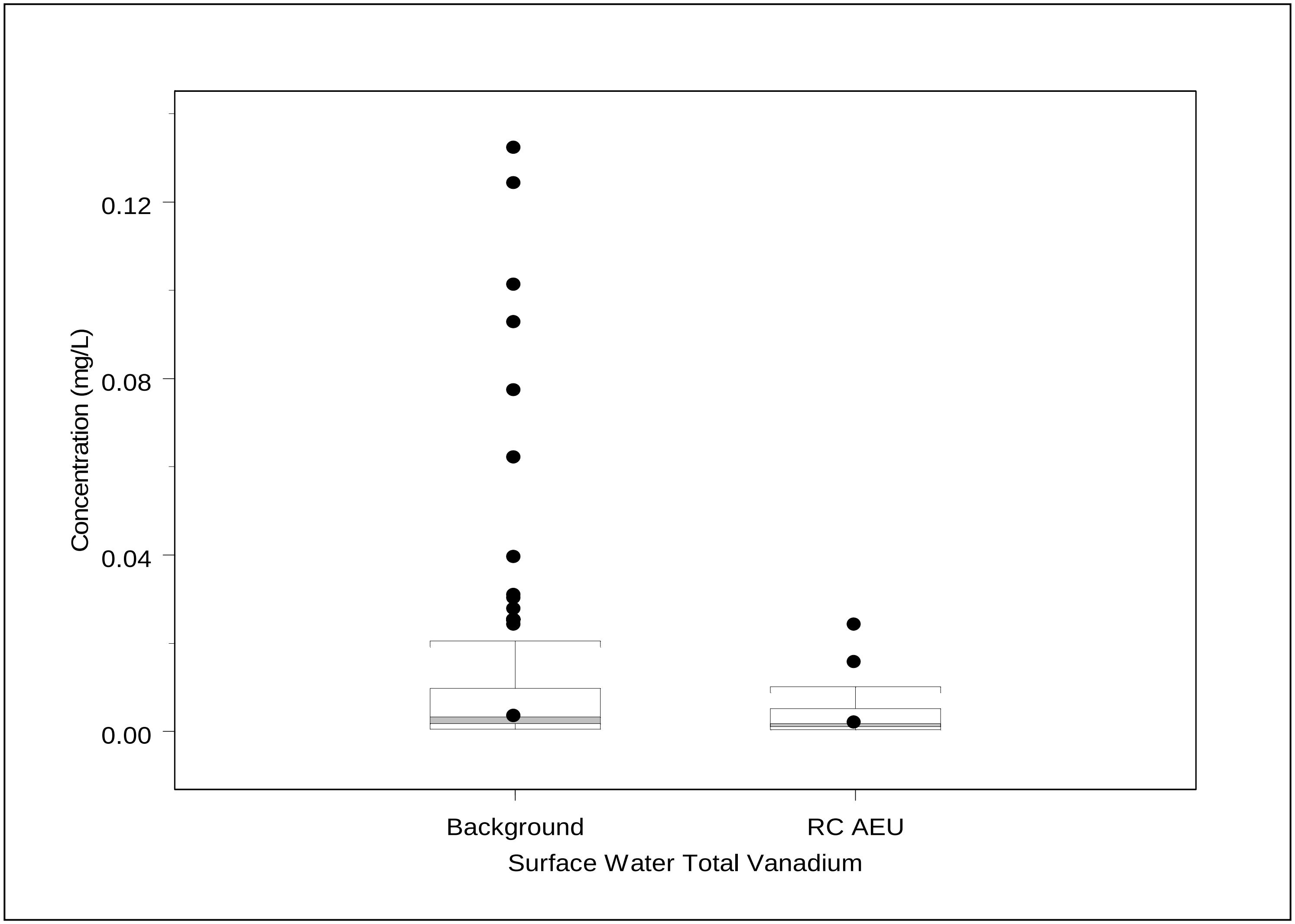
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.12
RC AEU Surface Water Total Box Plots for Selenium



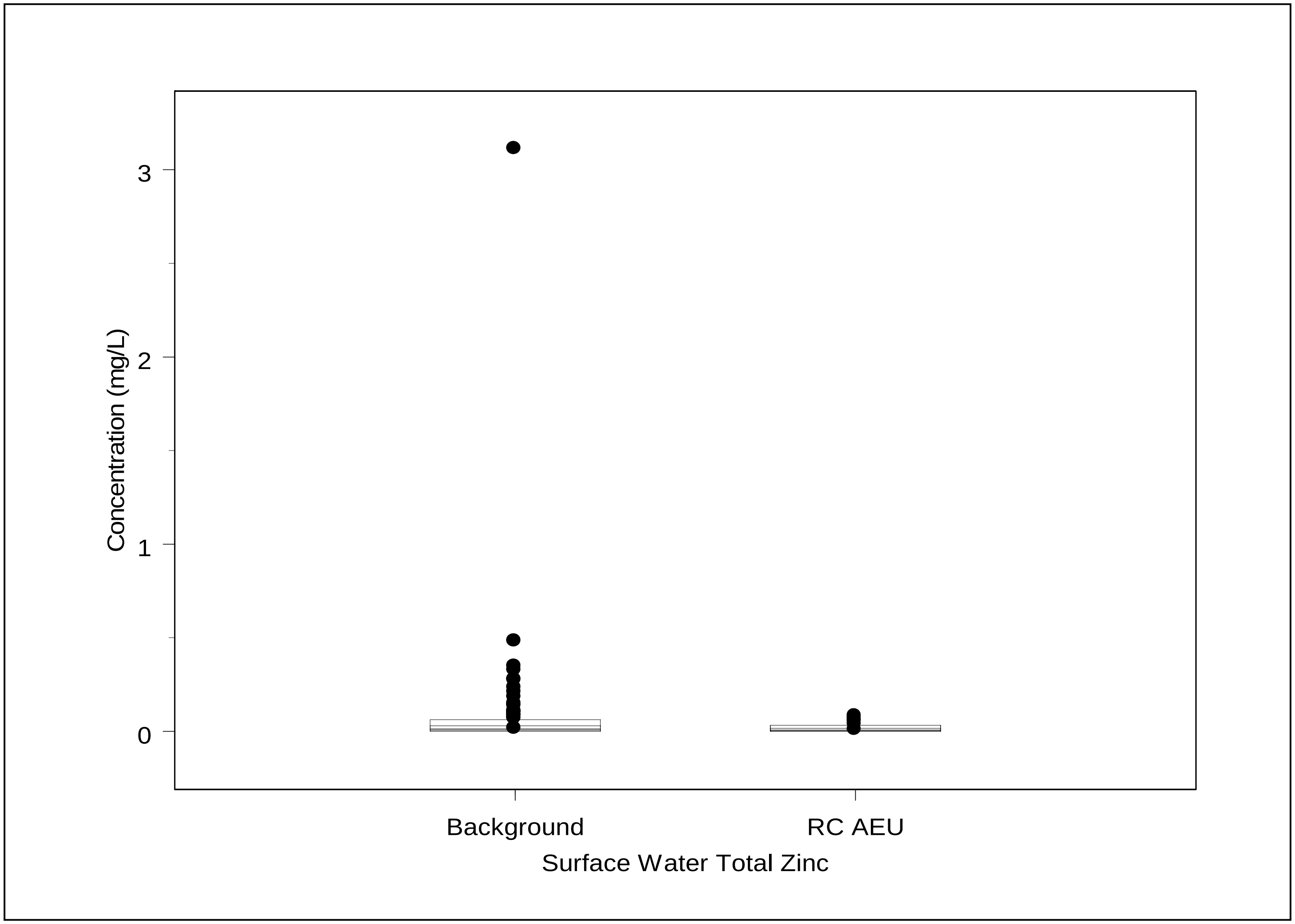
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.13
RC AEU Surface Water Total Box Plots for Vanadium



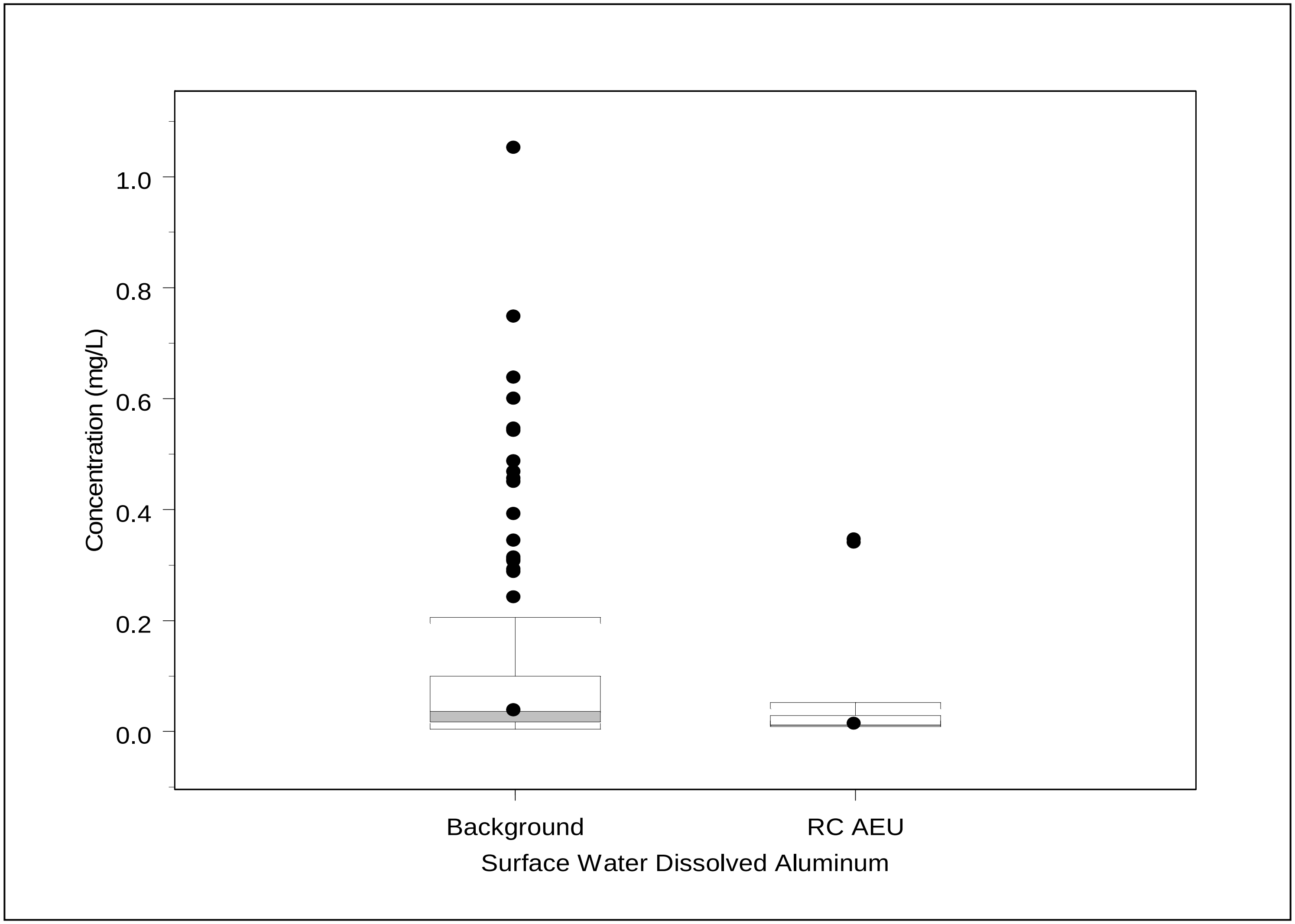
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.14
RC AEU Surface Water Total Box Plots for Zinc



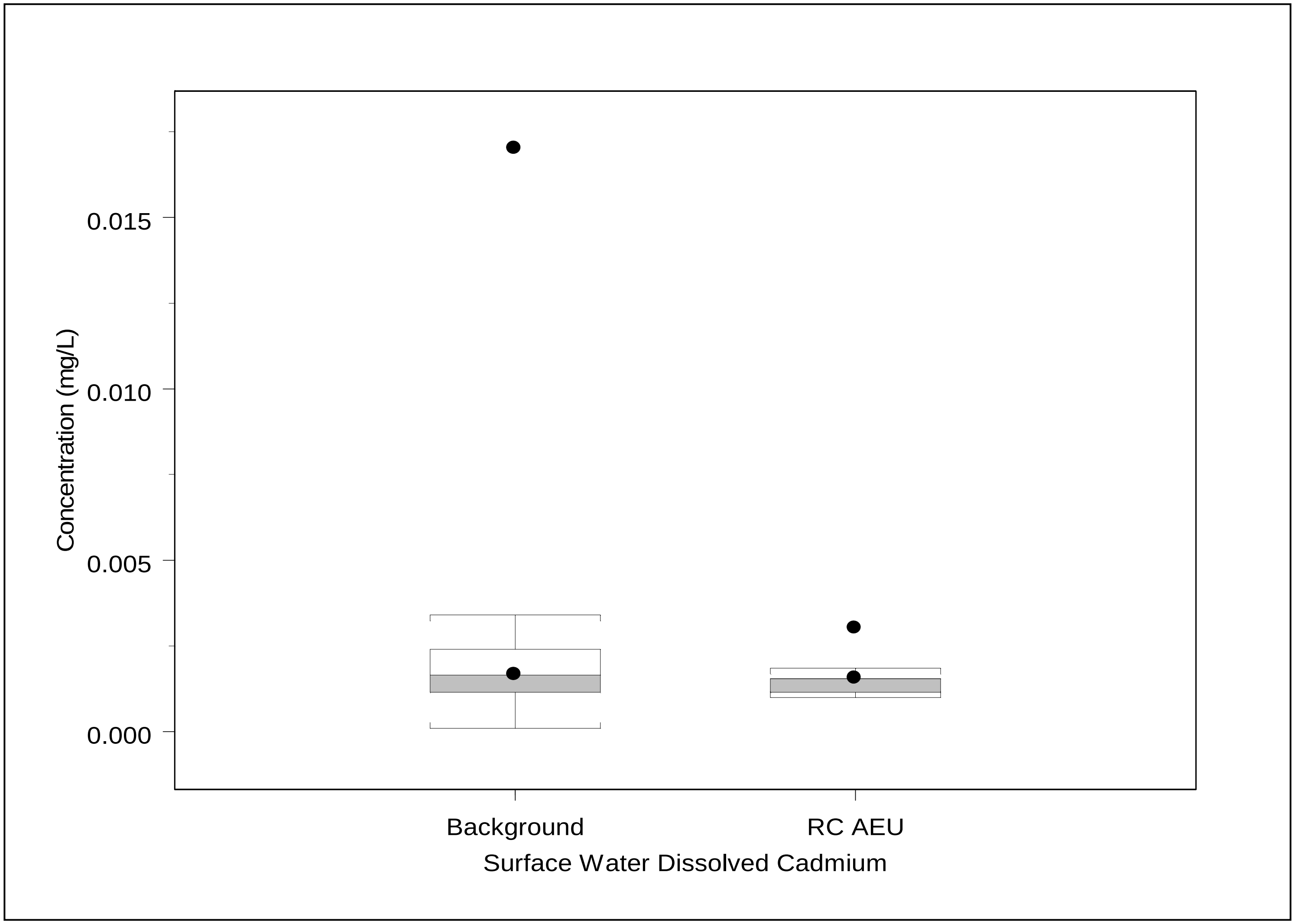
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.15
RC AEU Surface Water Dissolved Box Plots for Aluminum



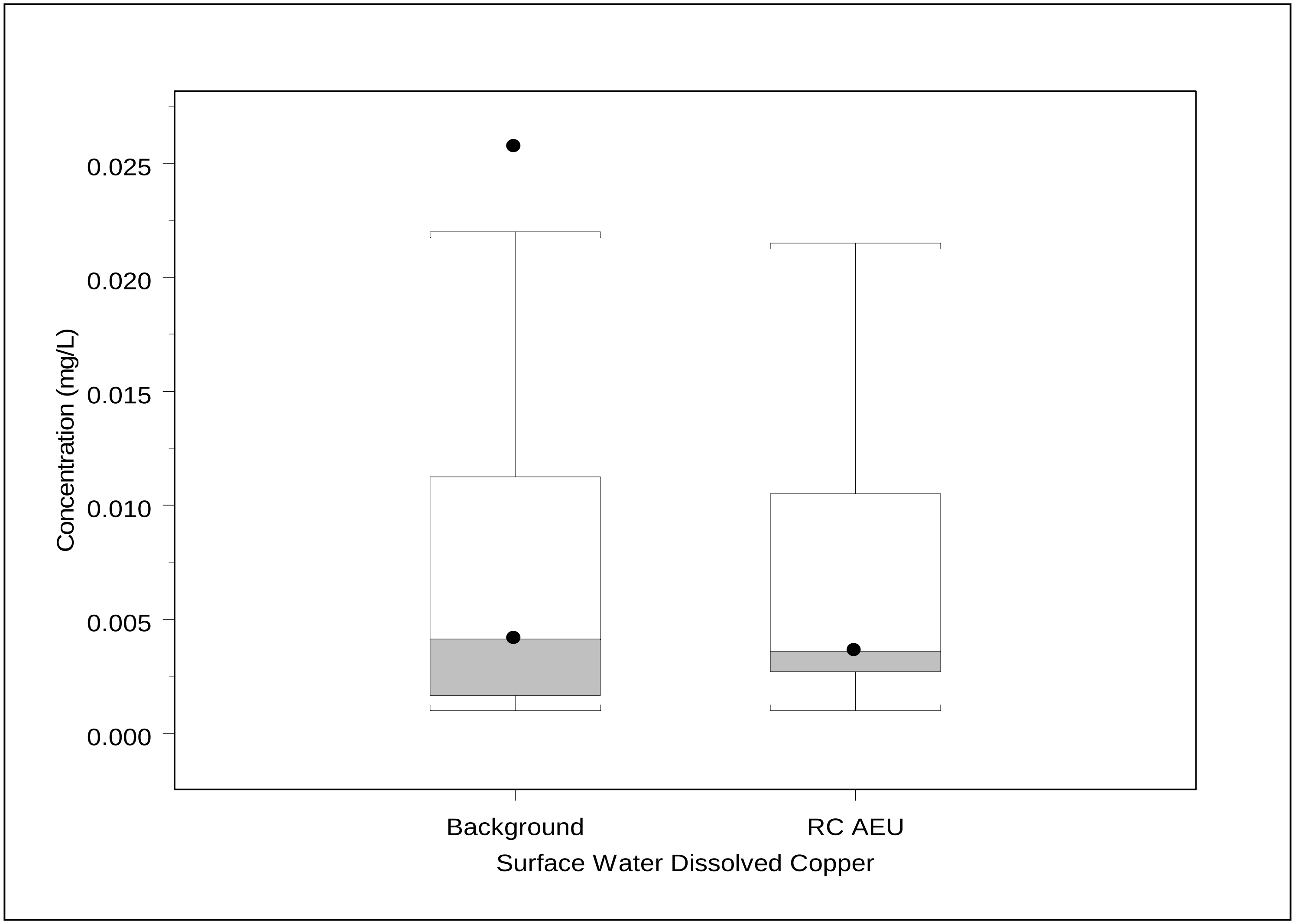
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.16
RC AEU Surface Water Dissolved Box Plots for Cadmium



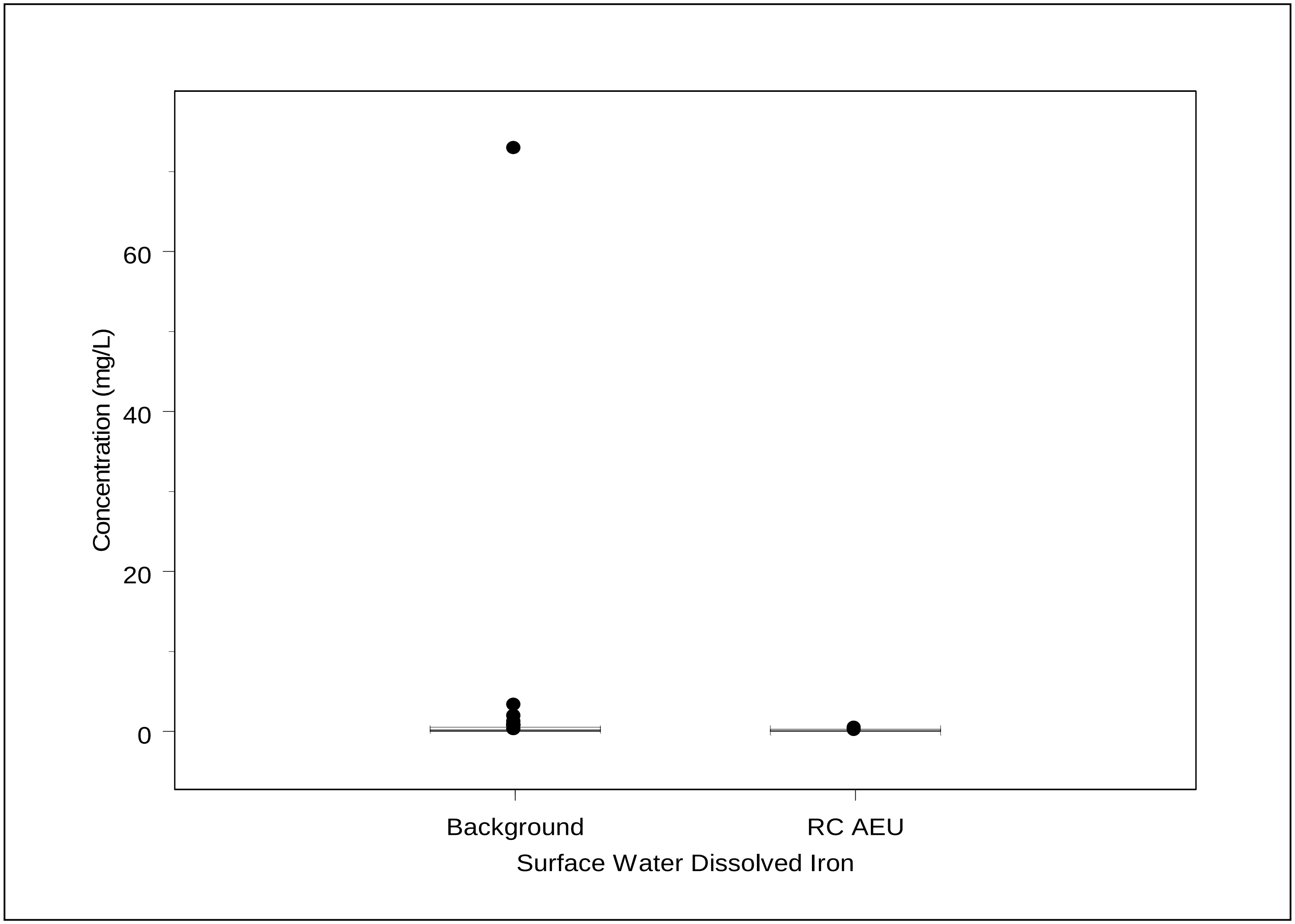
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.17
RC AEU Surface Water Dissolved Box Plots for Copper



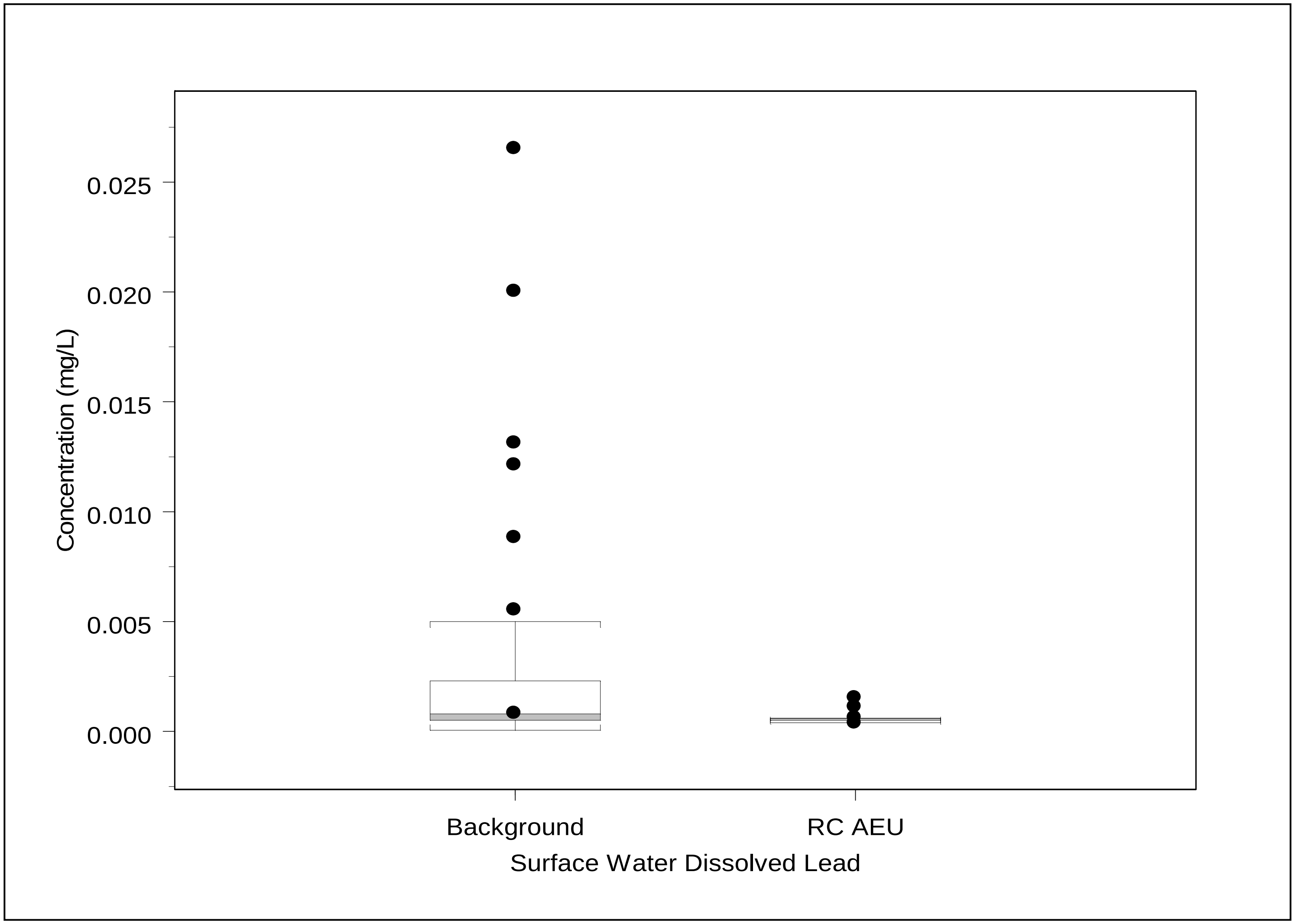
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.18
RC AEU Surface Water Dissolved Box Plots for Iron



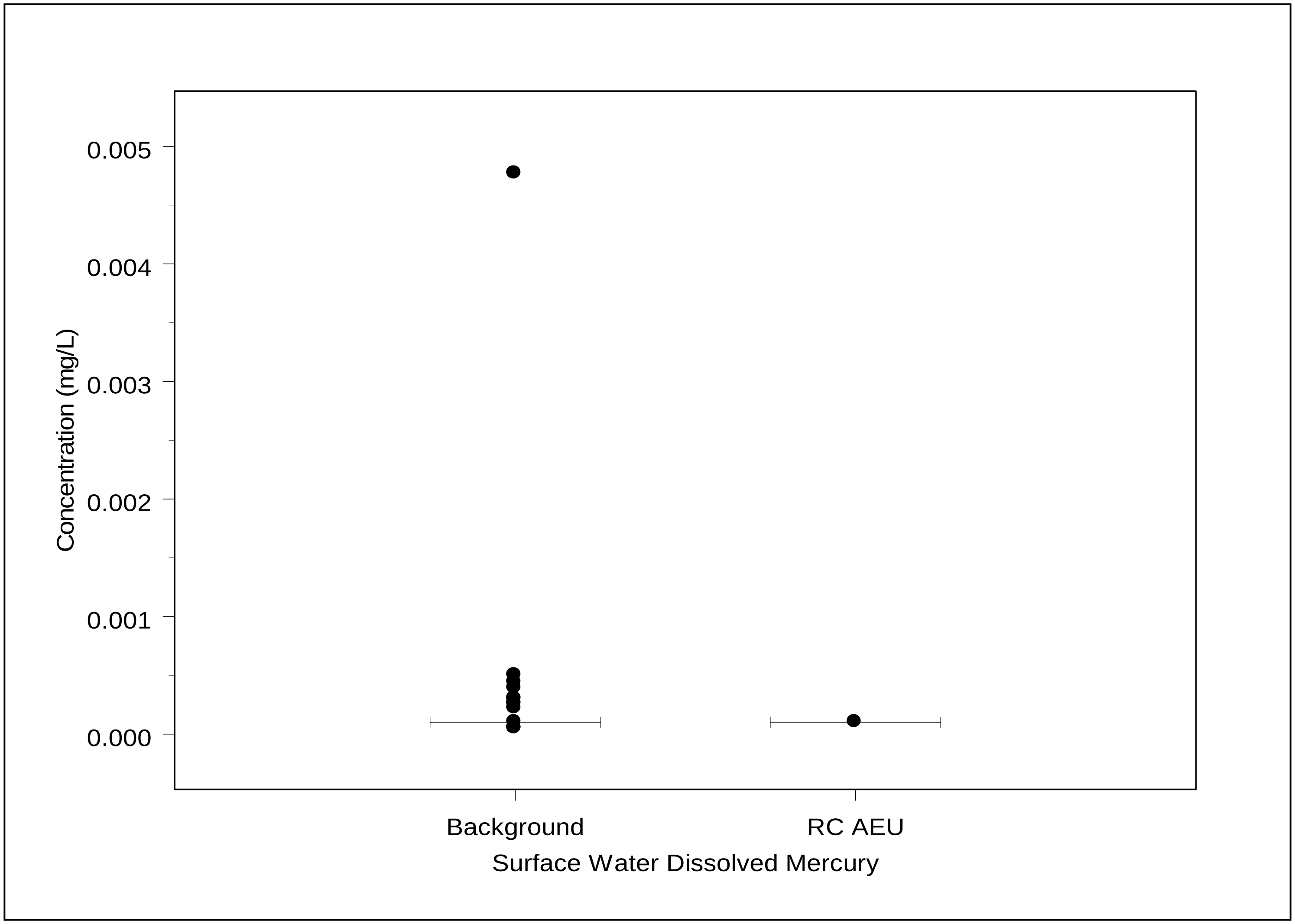
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.19
RC AEU Surface Water Dissolved Box Plots for Lead



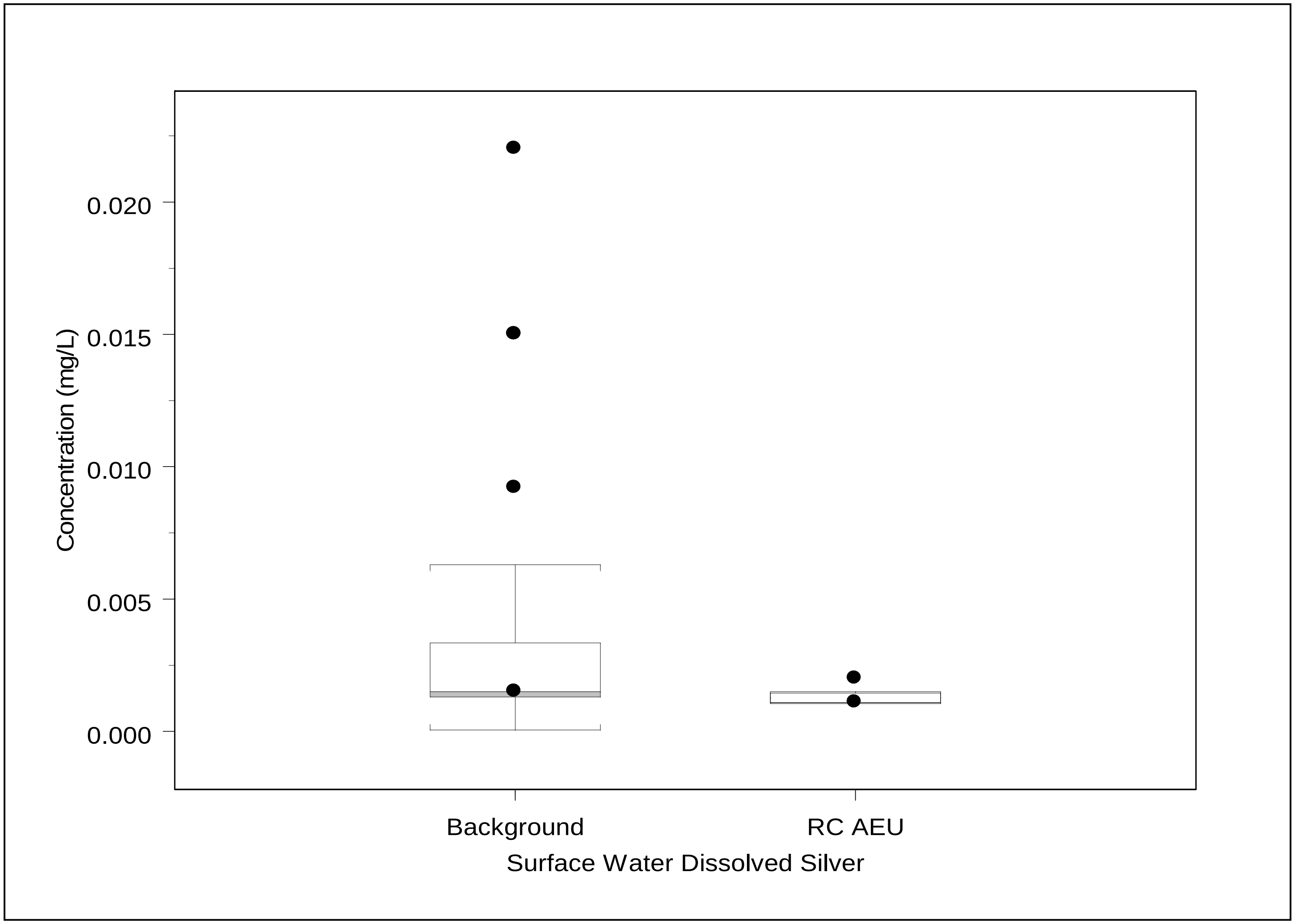
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.20
RC AEU Surface Water Dissolved Box Plots for Mercury



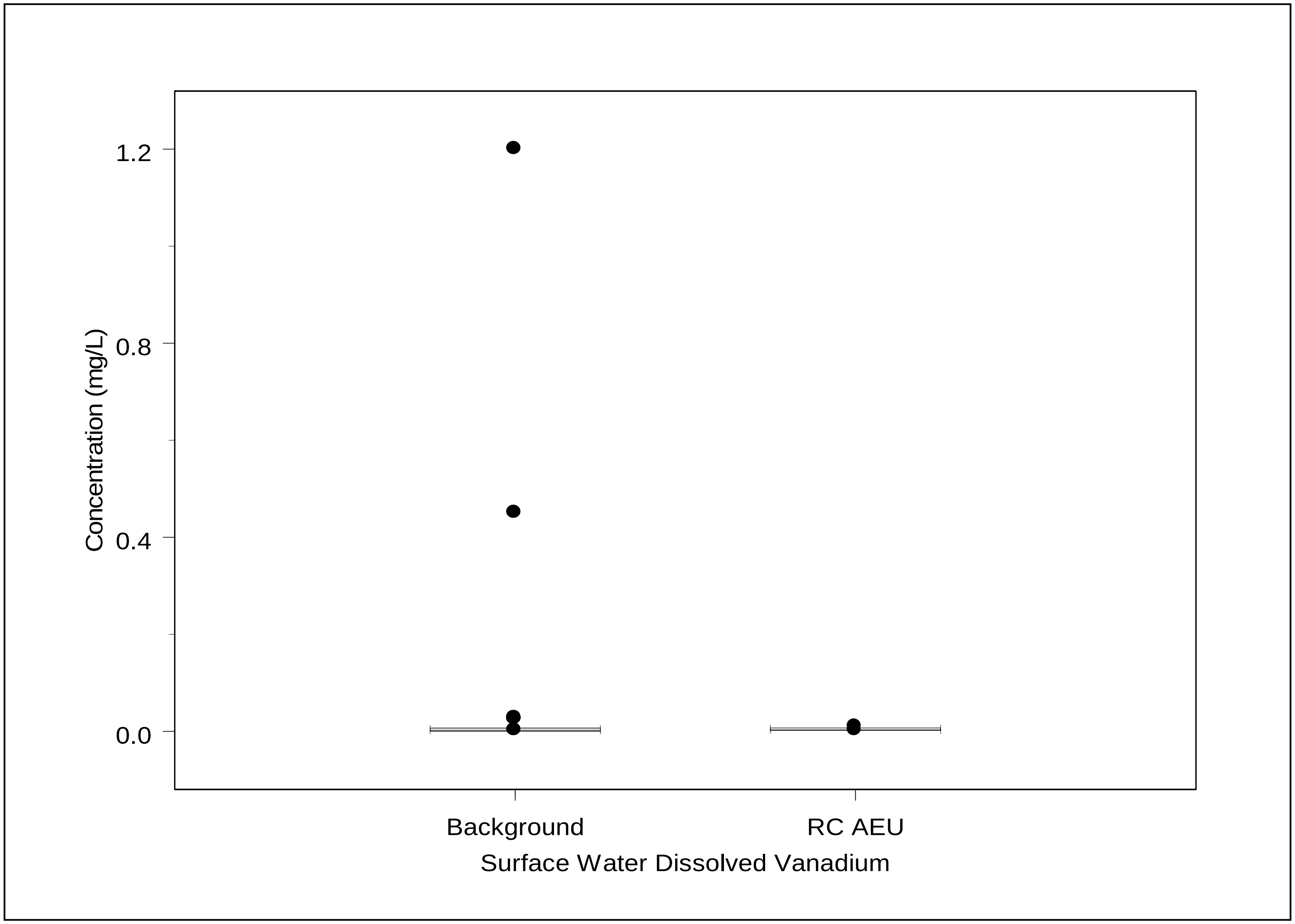
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.21
RC AEU Surface Water Dissolved Box Plots for Silver



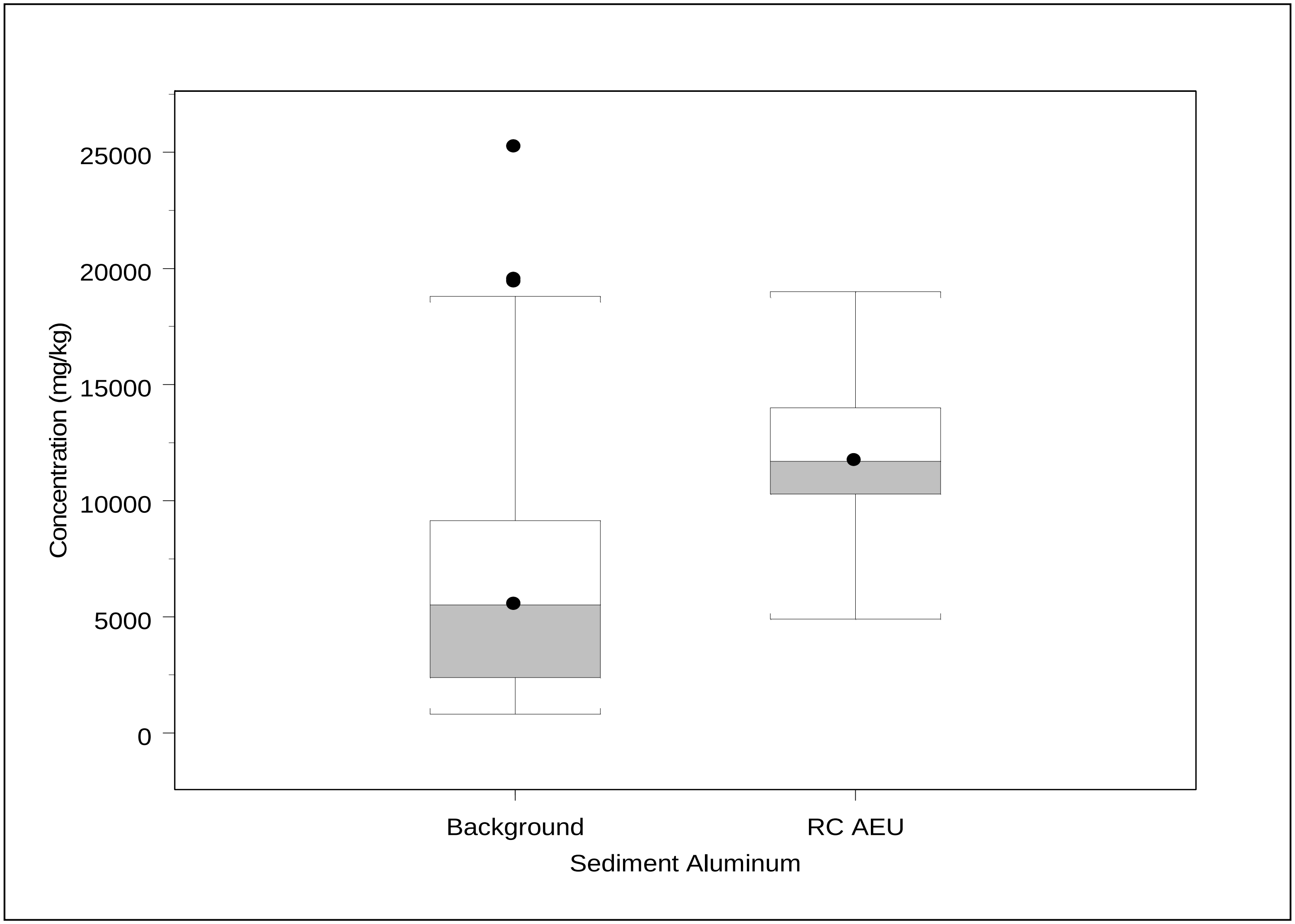
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.22
RC AEU Surface Water Dissolved Box Plots for Vanadium



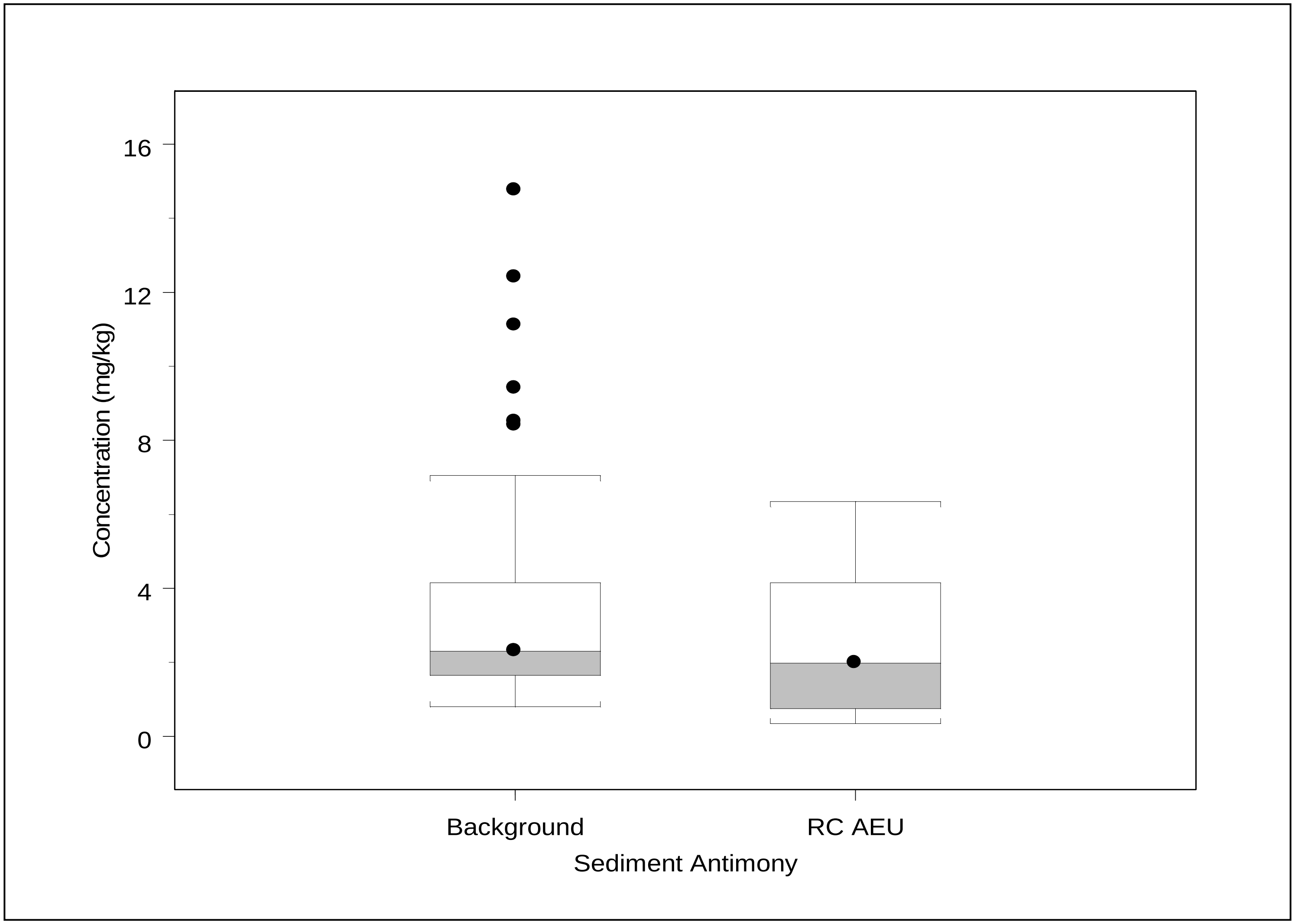
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.23
RC AEU Sediment Box Plots for Aluminum



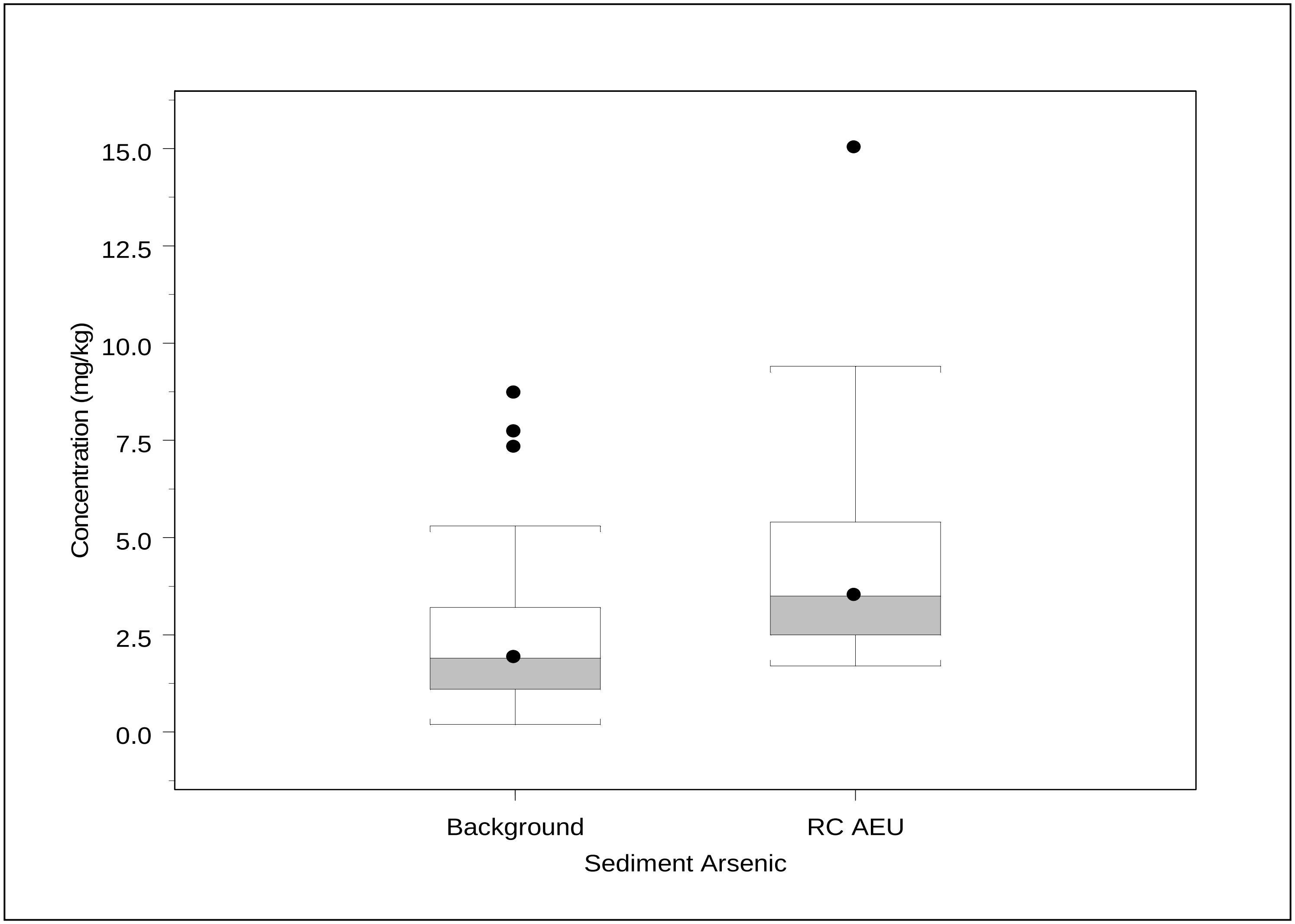
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.24
RC AEU Sediment Box Plots for Antimony



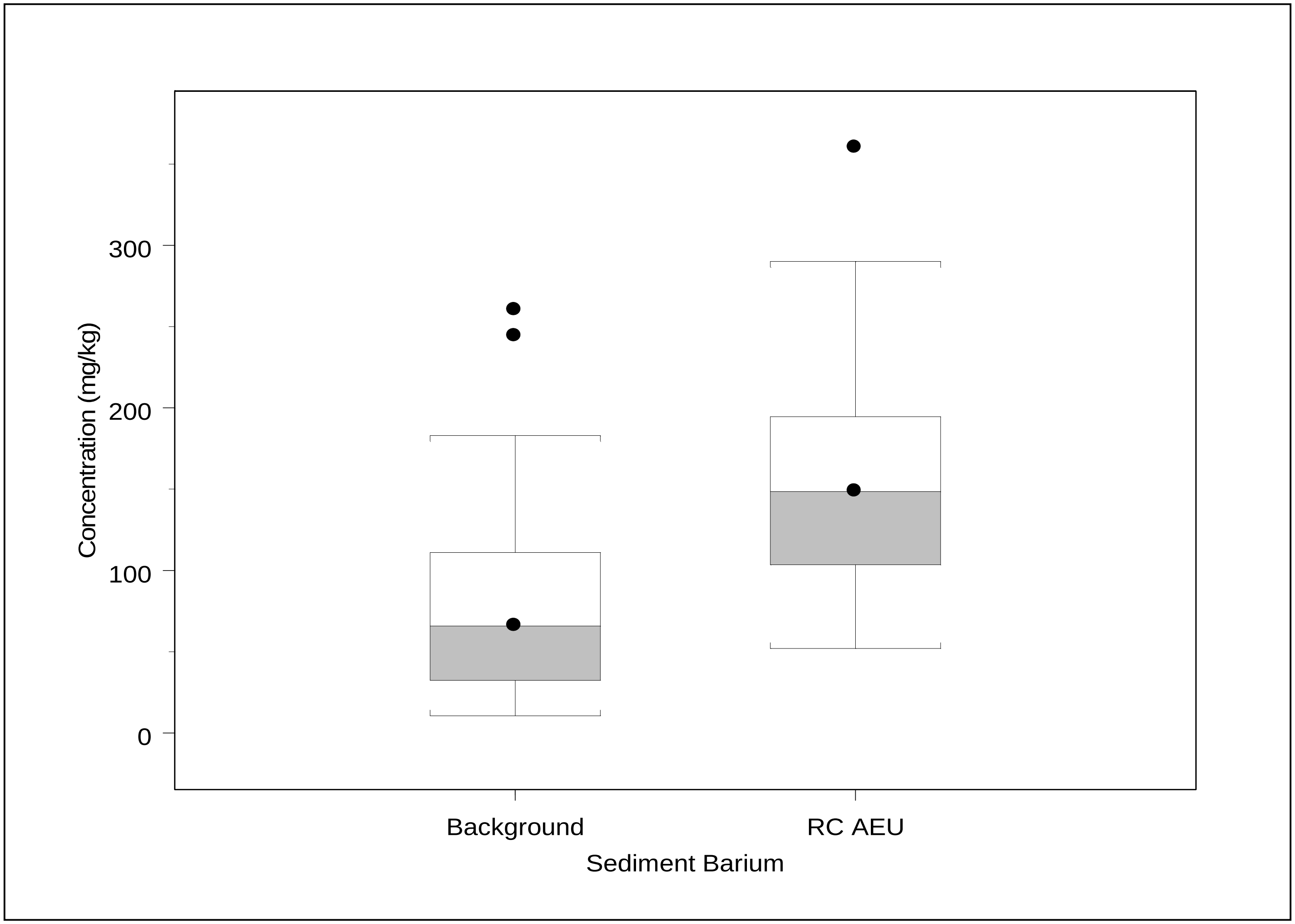
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.25
RC AEU Sediment Box Plots for Arsenic



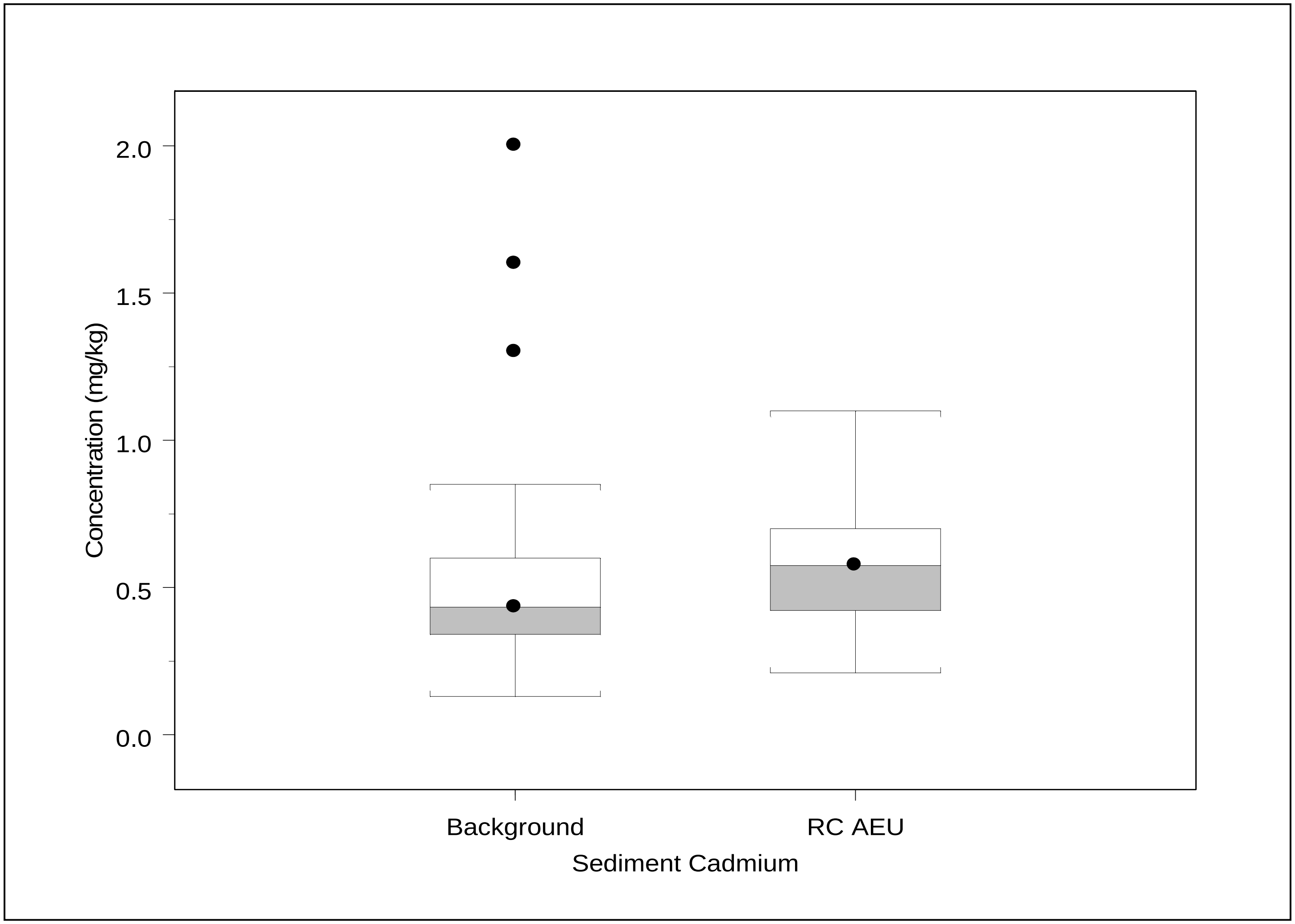
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.26
RC AEU Sediment Box Plots for Barium



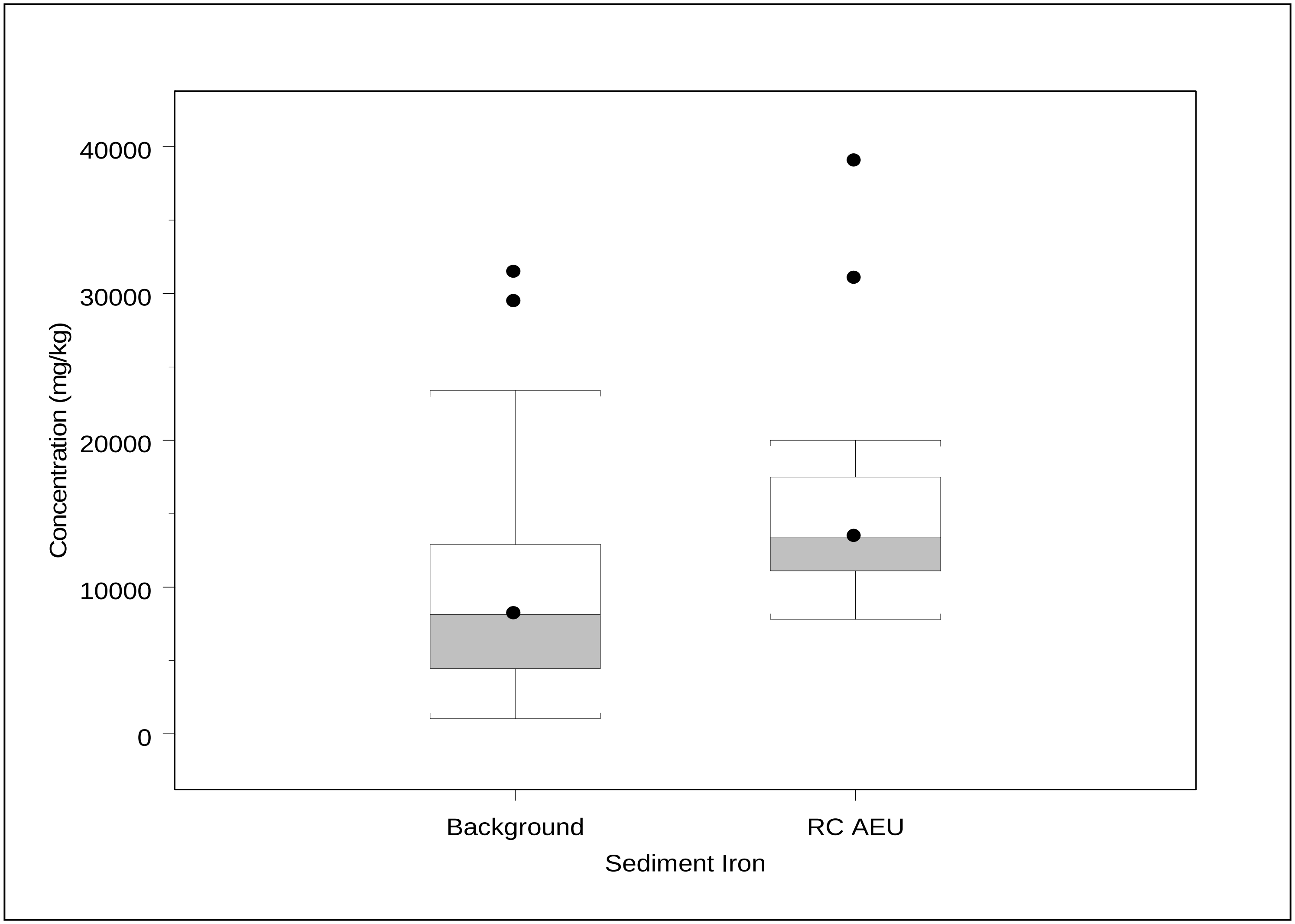
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.27
RC AEU Sediment Box Plots for Cadmium



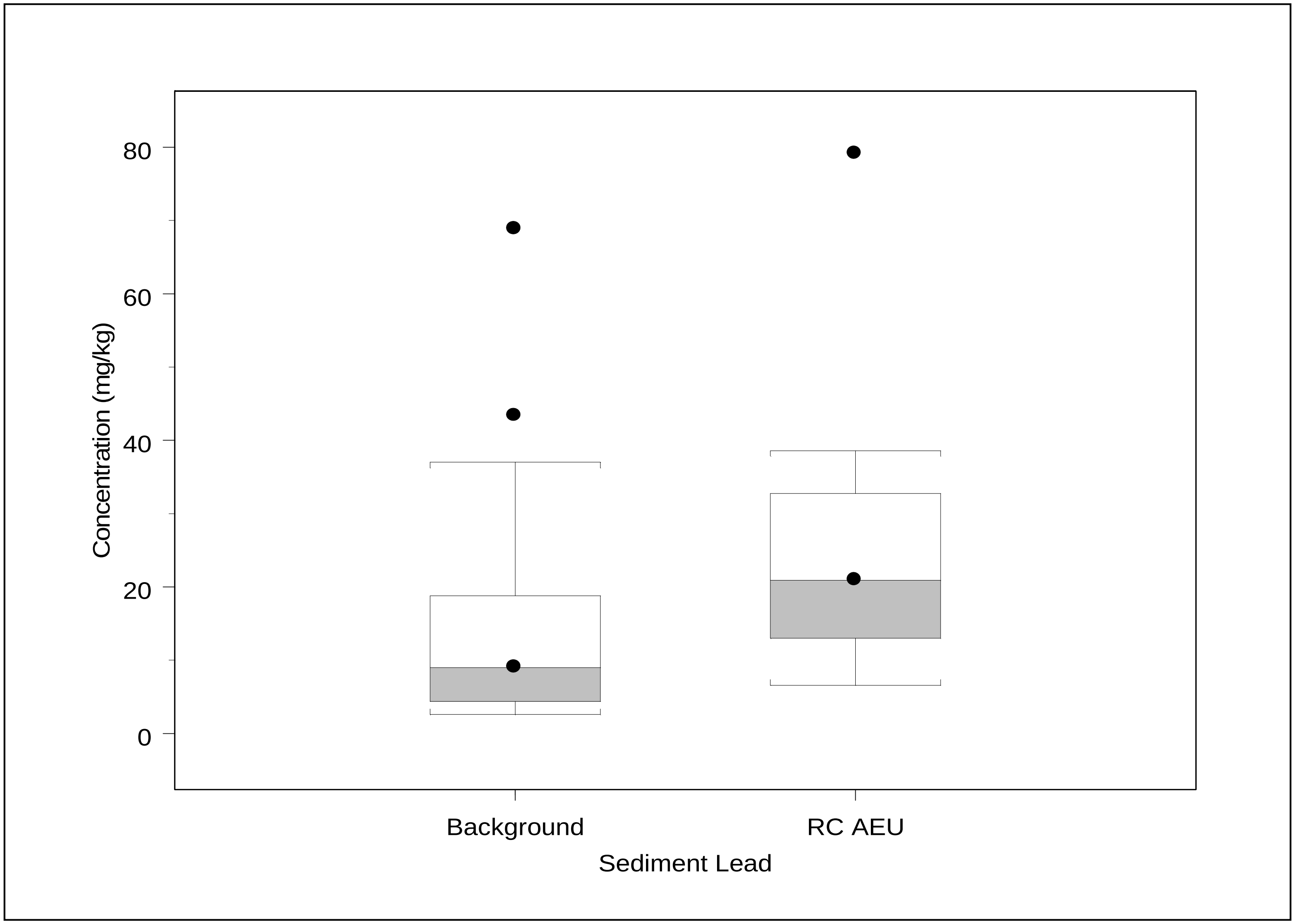
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.28
RC AEU Sediment Box Plots for Iron



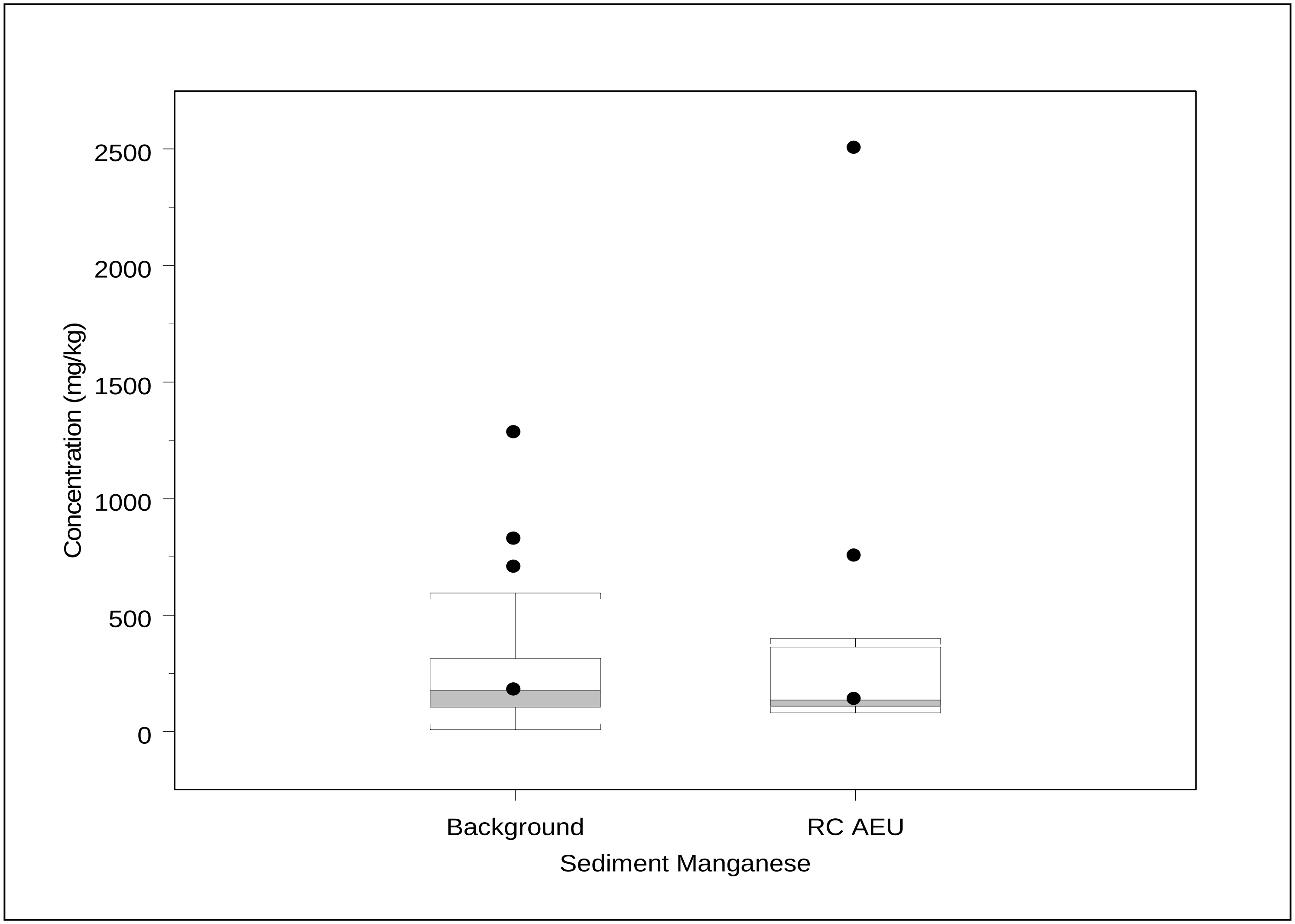
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.29
RC AEU Sediment Box Plots for Lead



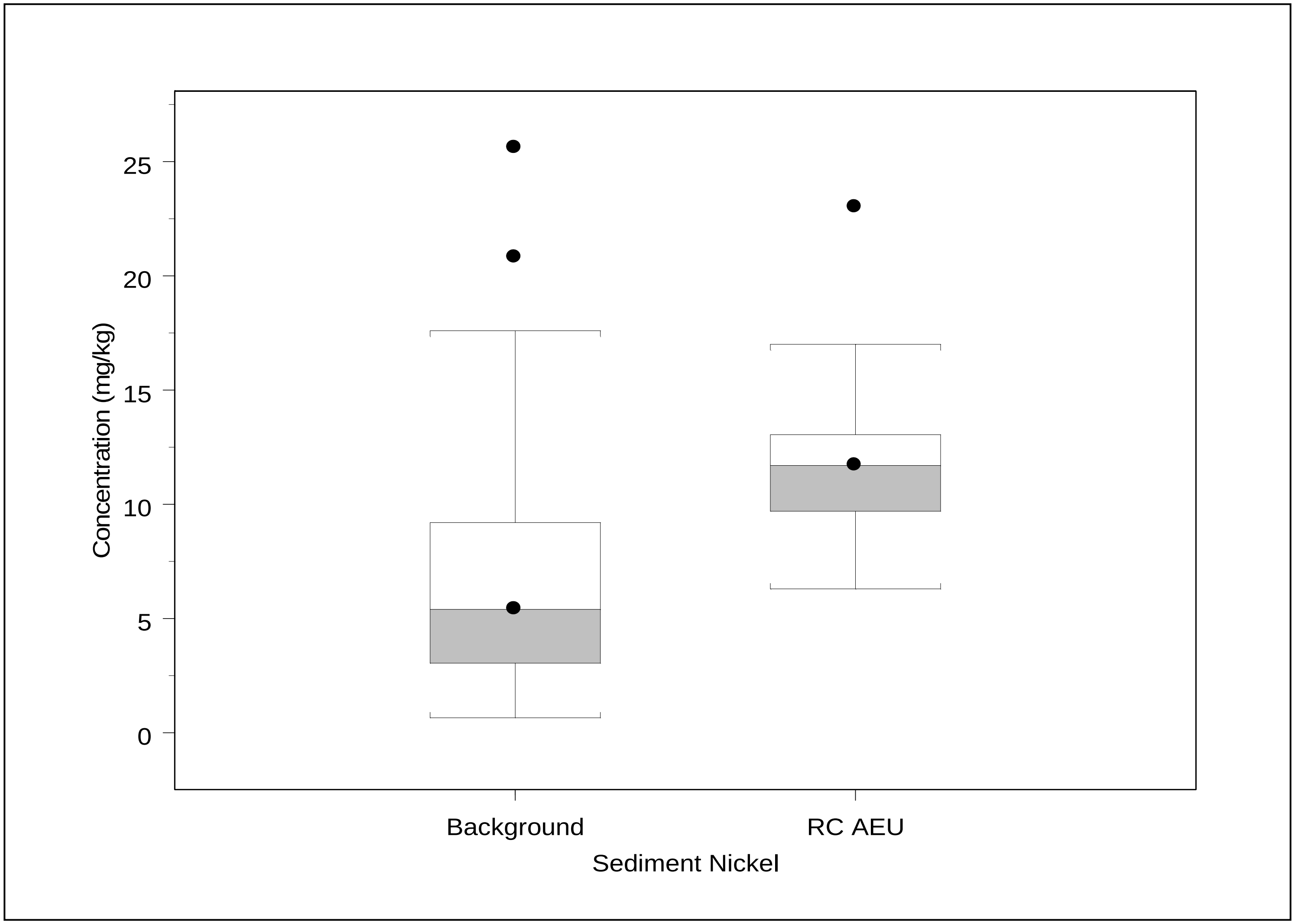
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.30
RC AEU Sediment Box Plots for Manganese



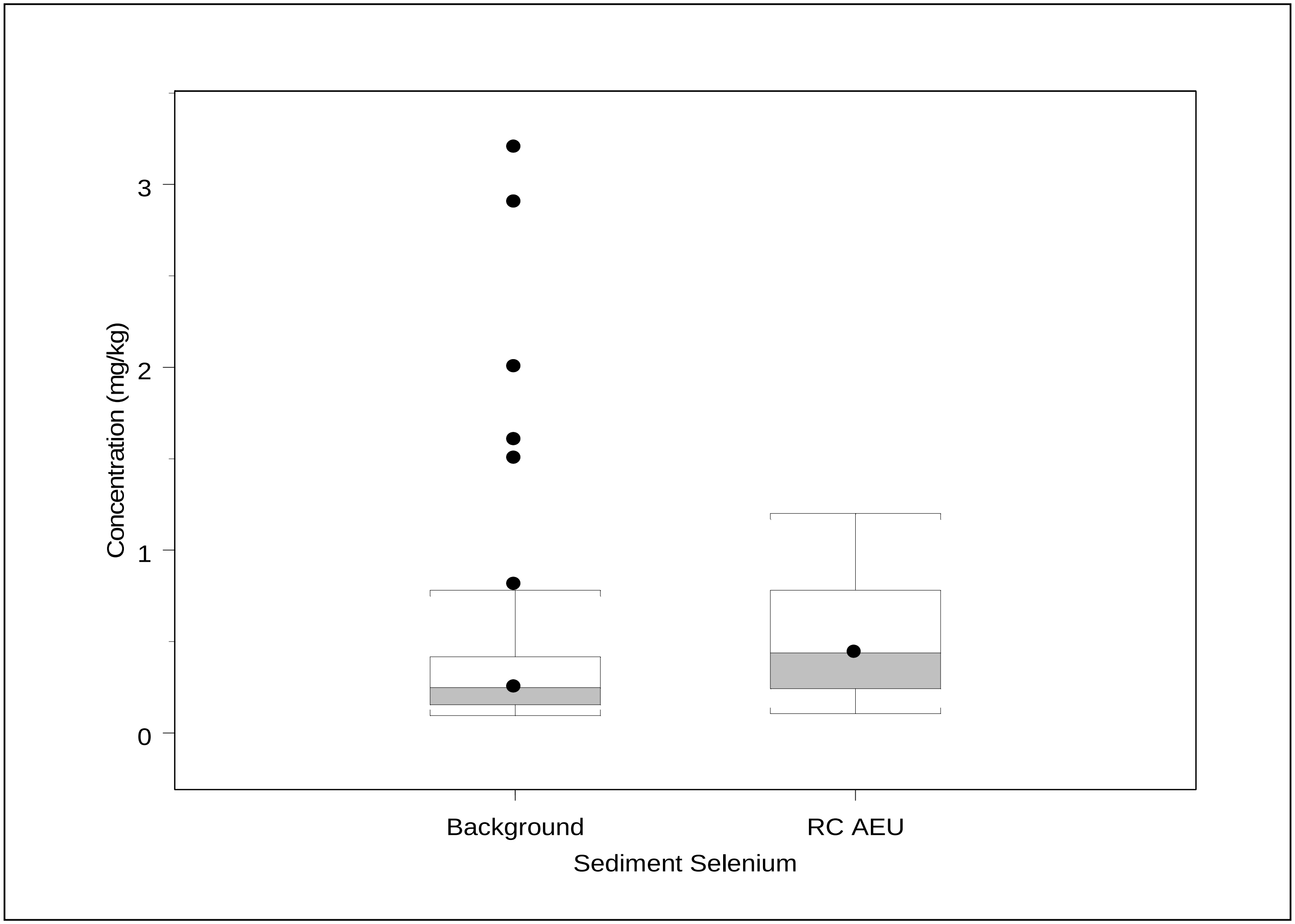
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.31
RC AEU Sediment Box Plots for Nickel



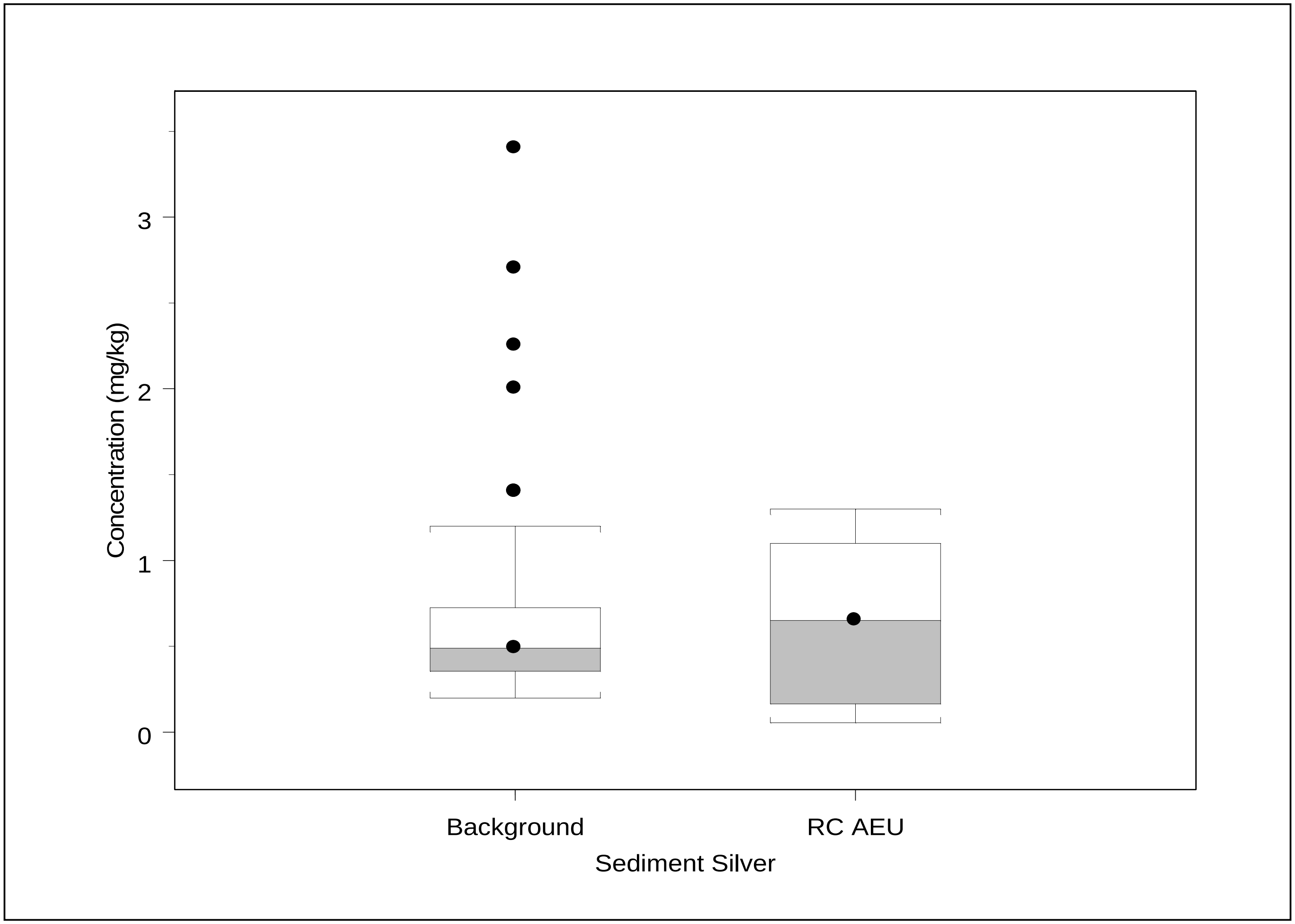
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.32
RC AEU Sediment Box Plots for Selenium



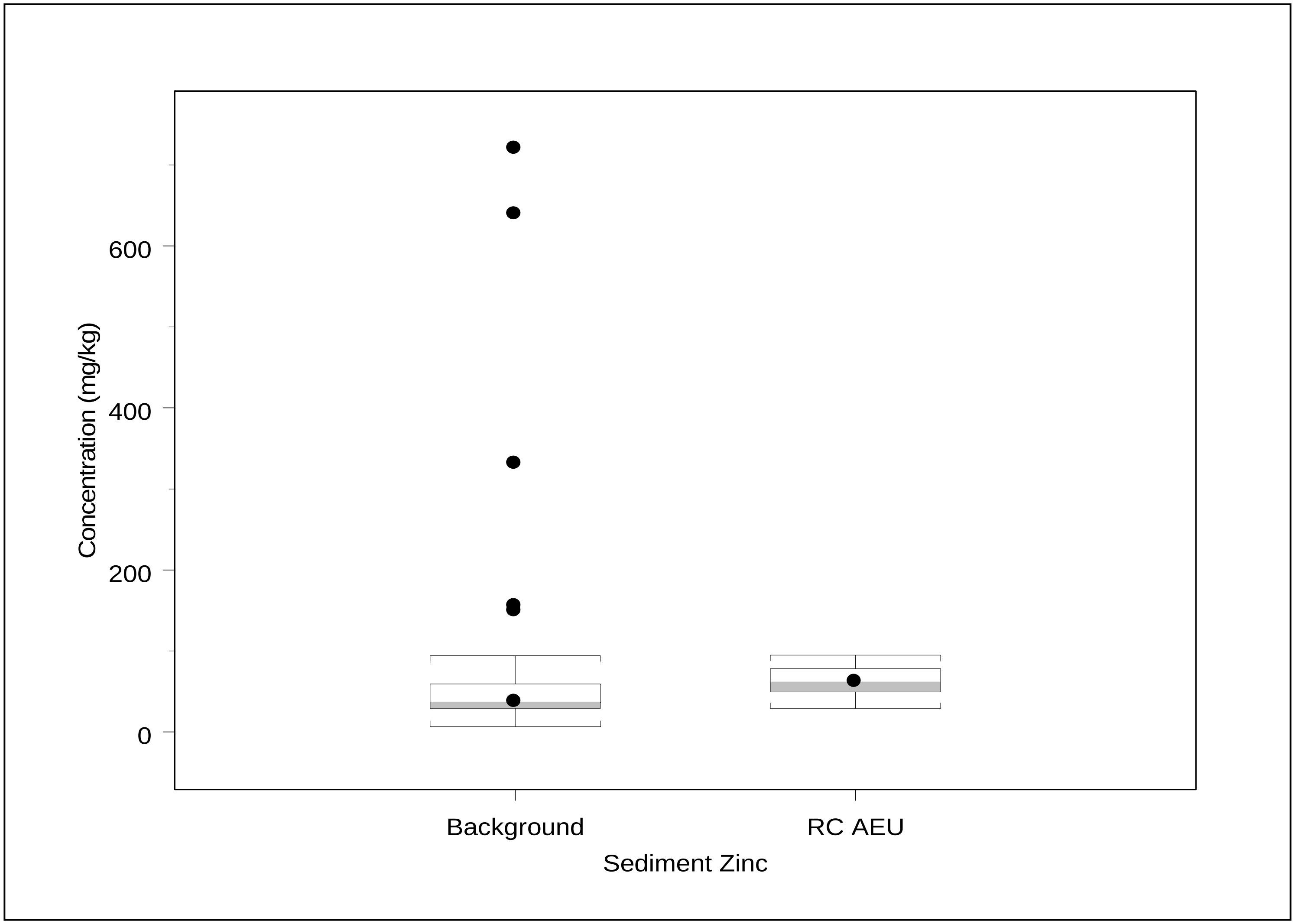
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.33
RC AEU Sediment Box Plots for Silver



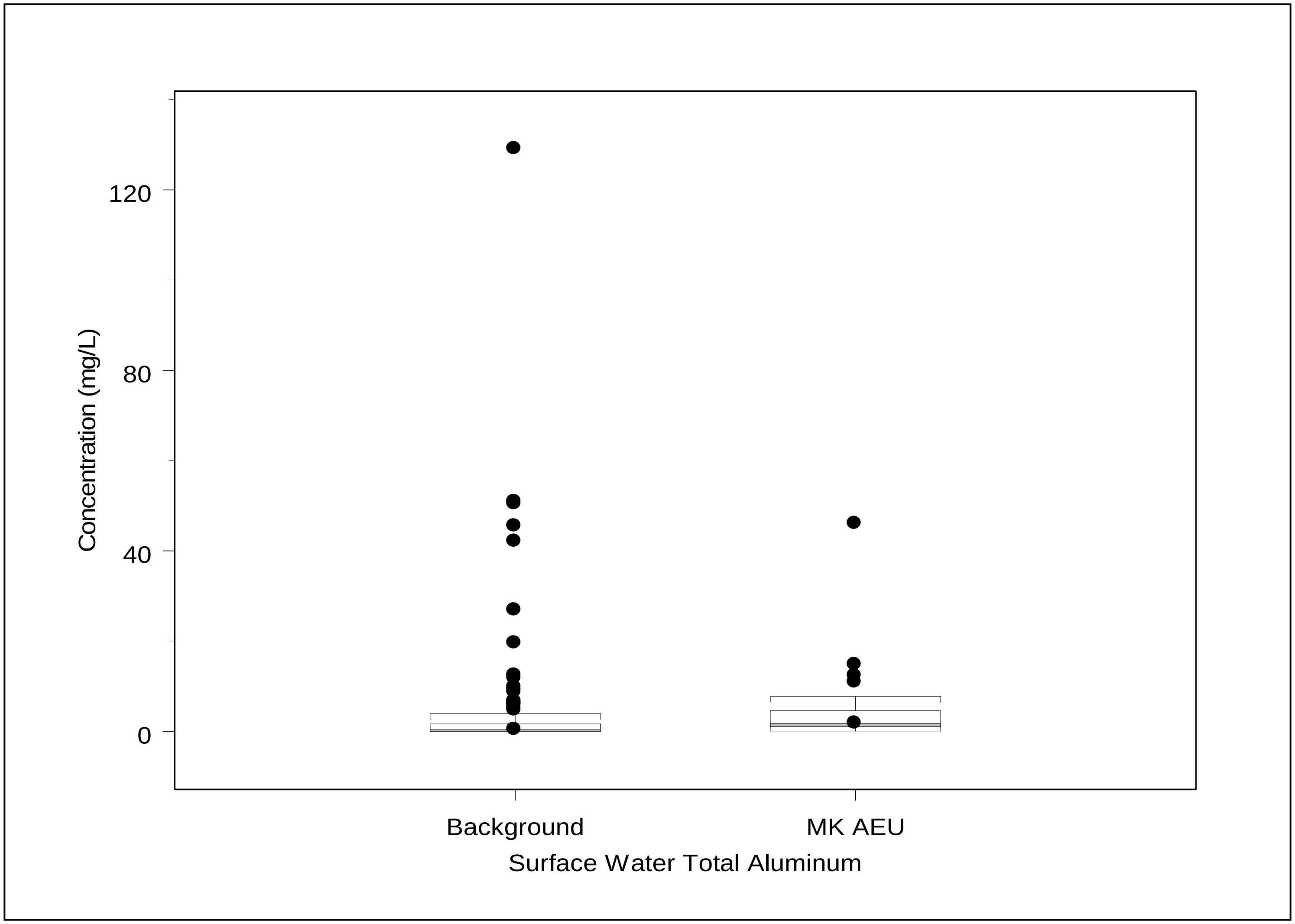
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.RC AEU.34
RC AEU Sediment Box Plots for Zinc



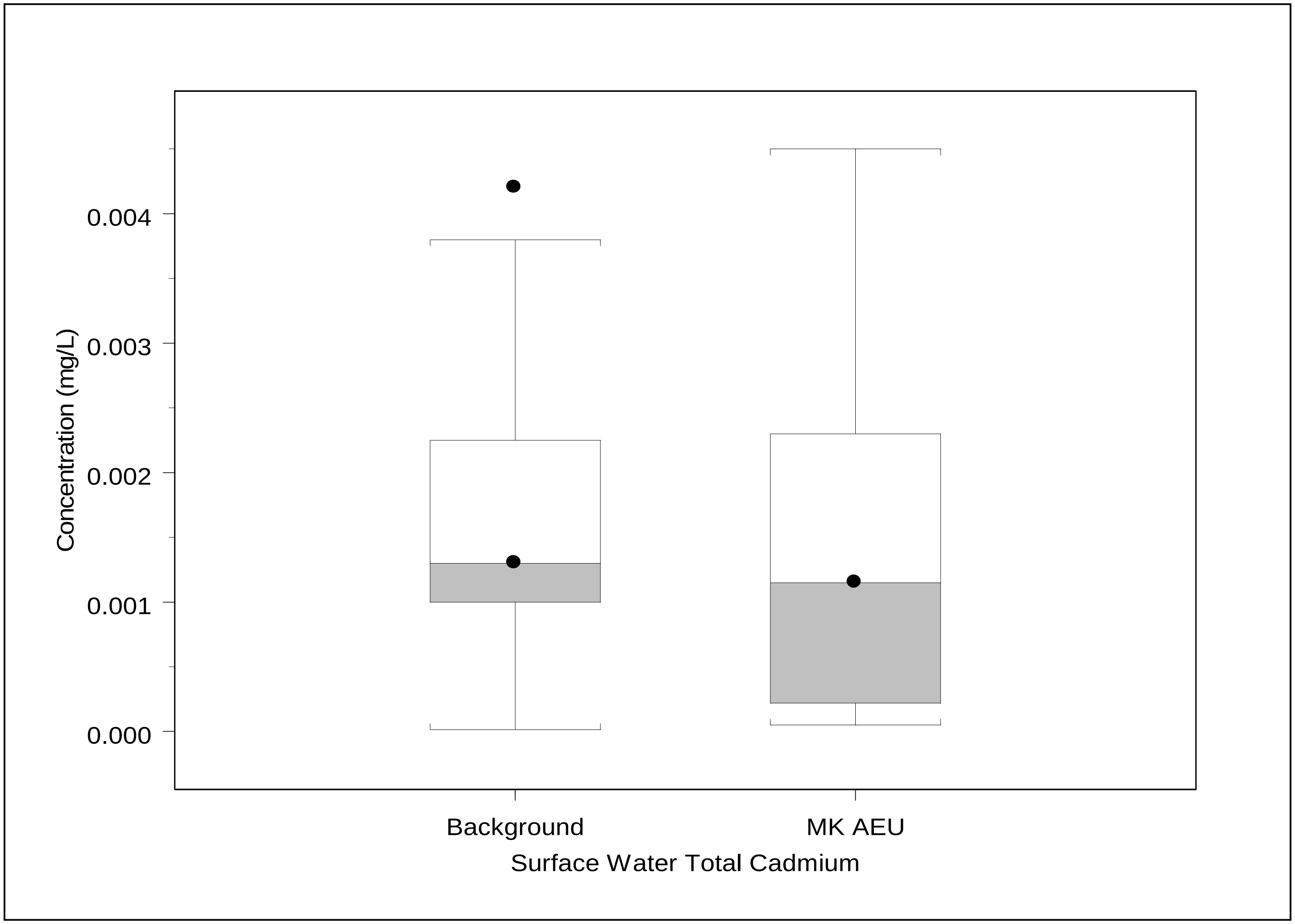
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.1
MK AEU Surface Water Total Box Plots for Aluminum



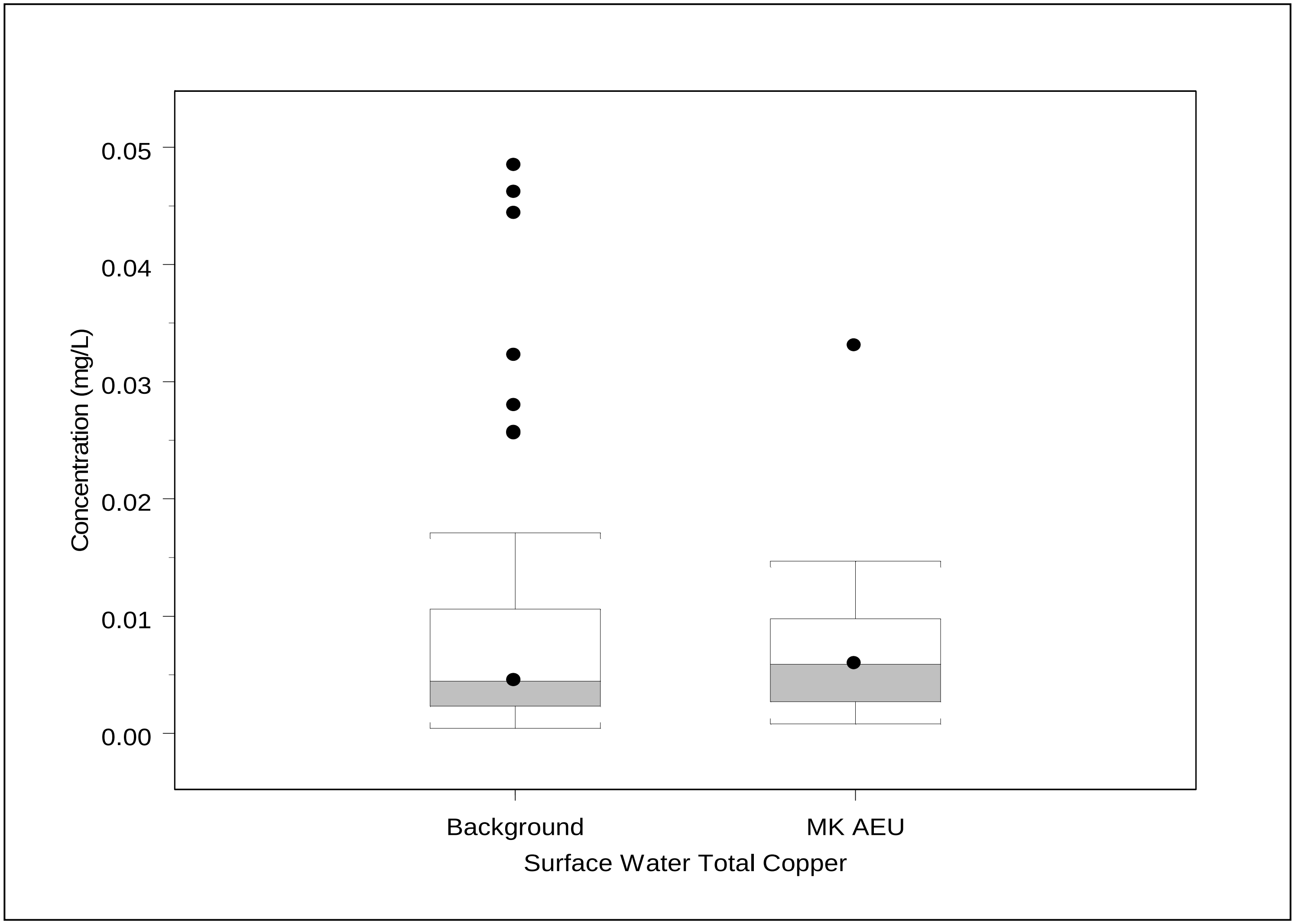
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.2
MK AEU Surface Water Total Box Plots for Cadmium



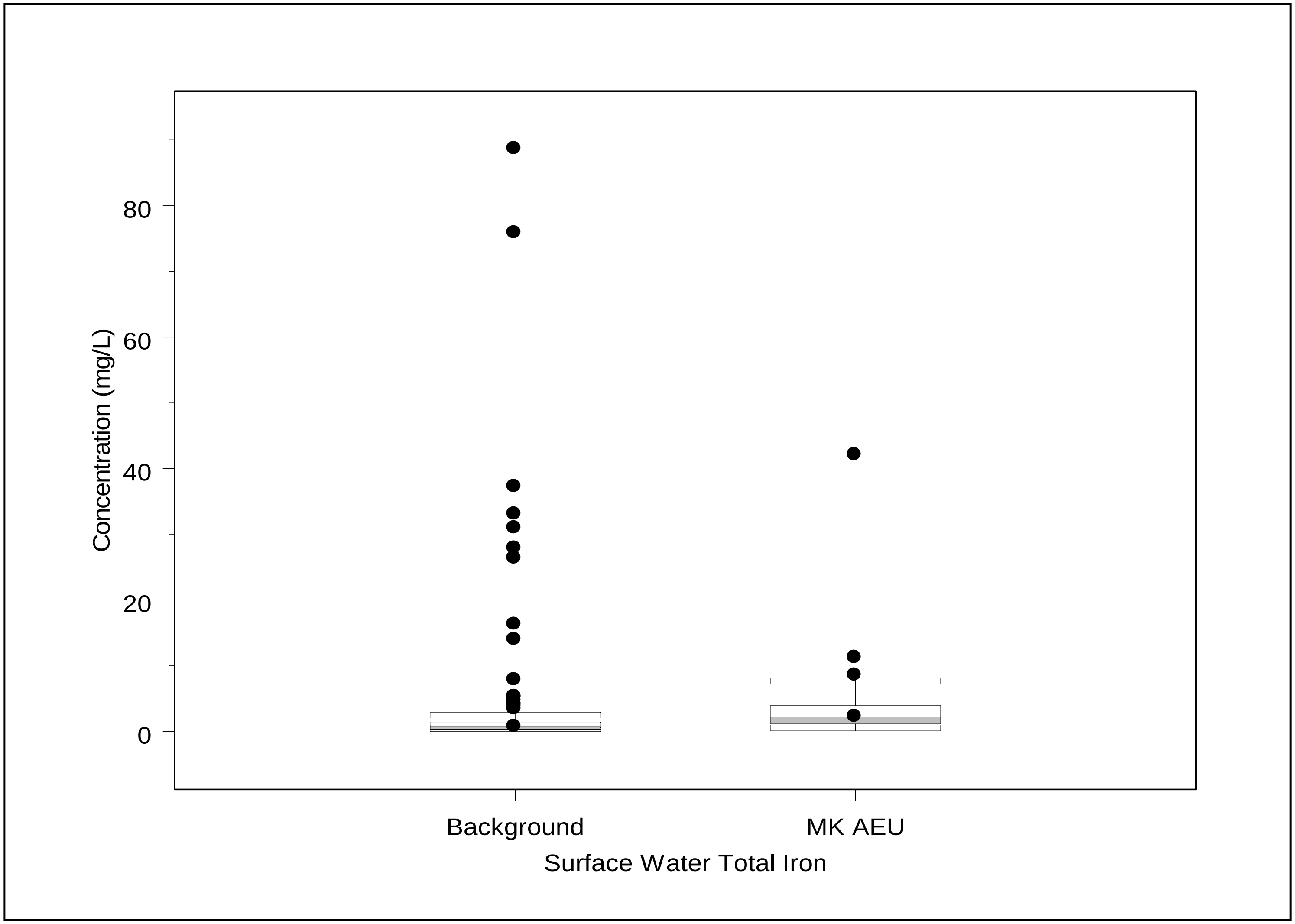
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.3
MK AEU Surface Water Total Box Plots for Copper



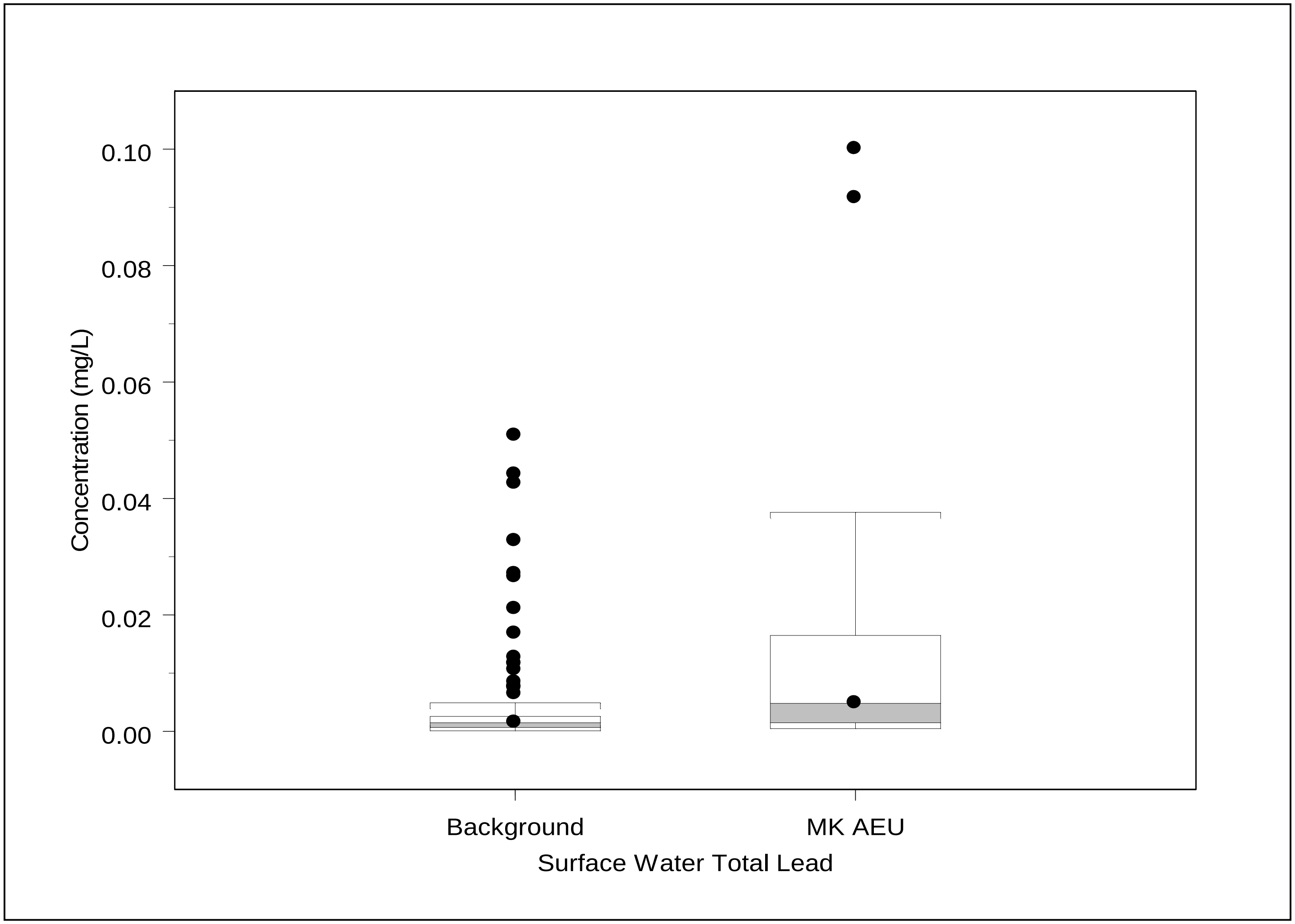
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.4
MK AEU Surface Water Total Box Plots for Iron



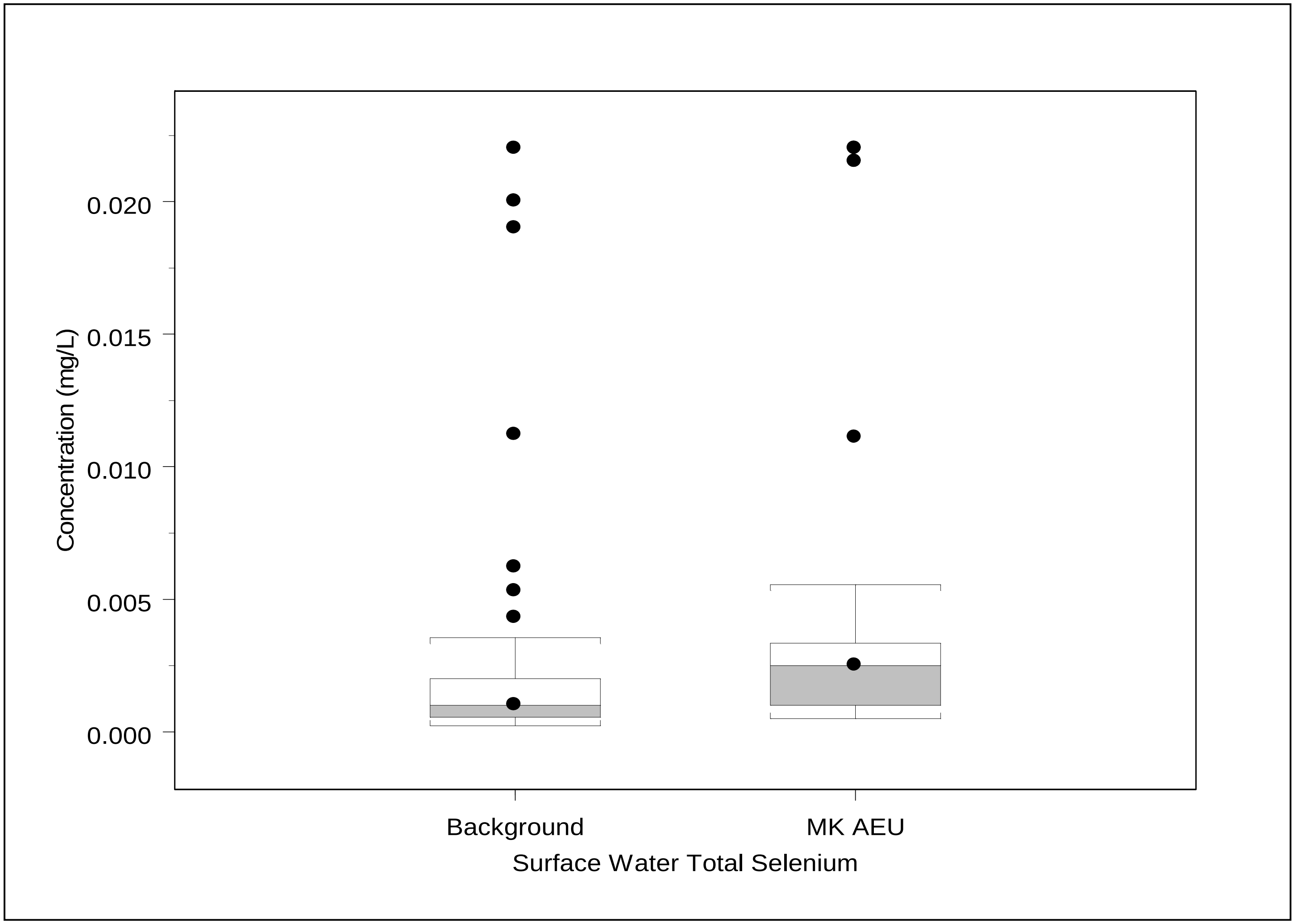
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.5
MK AEU Surface Water Total Box Plots for Lead



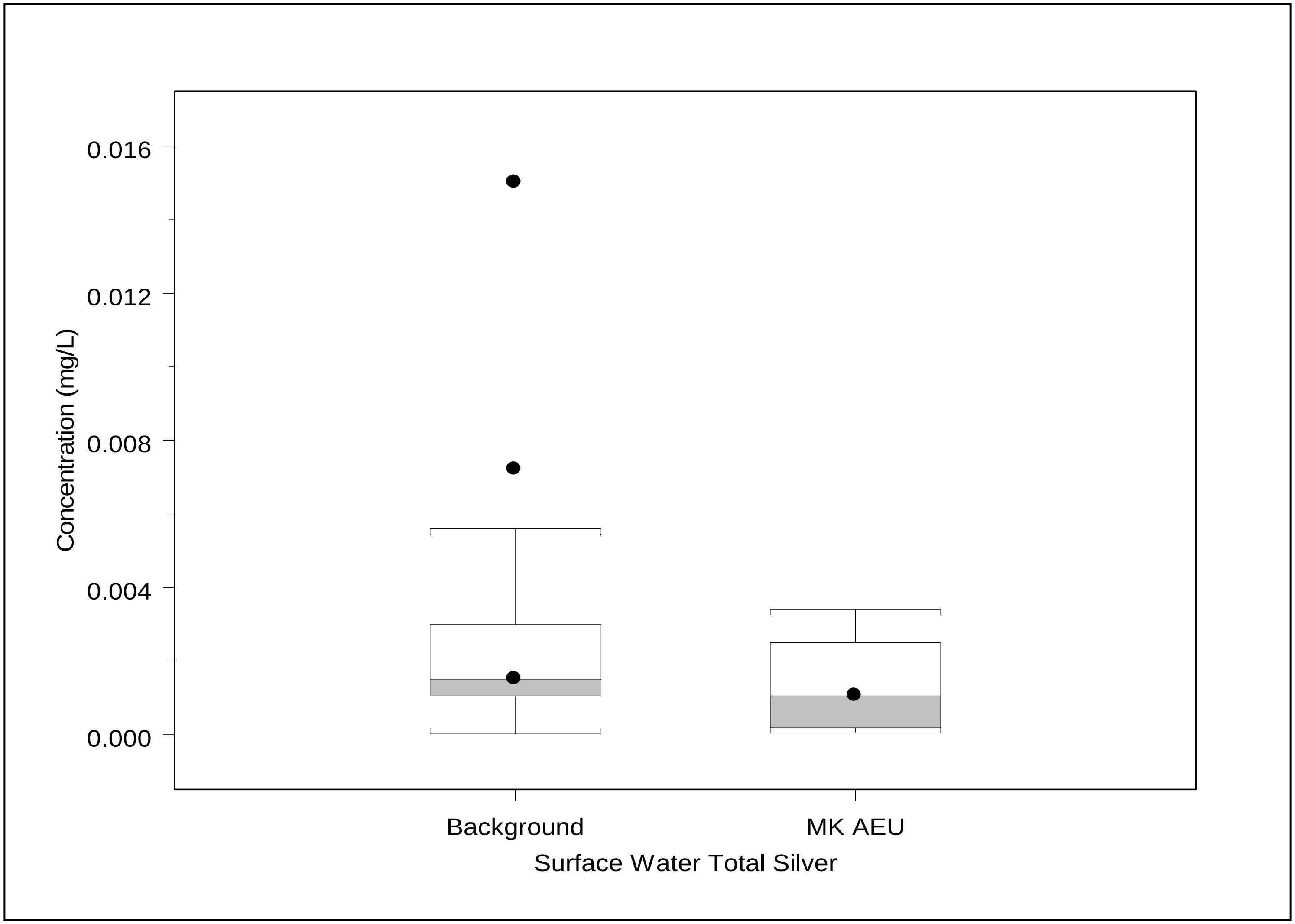
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.6
MK AEU Surface Water Total Box Plots for Selenium



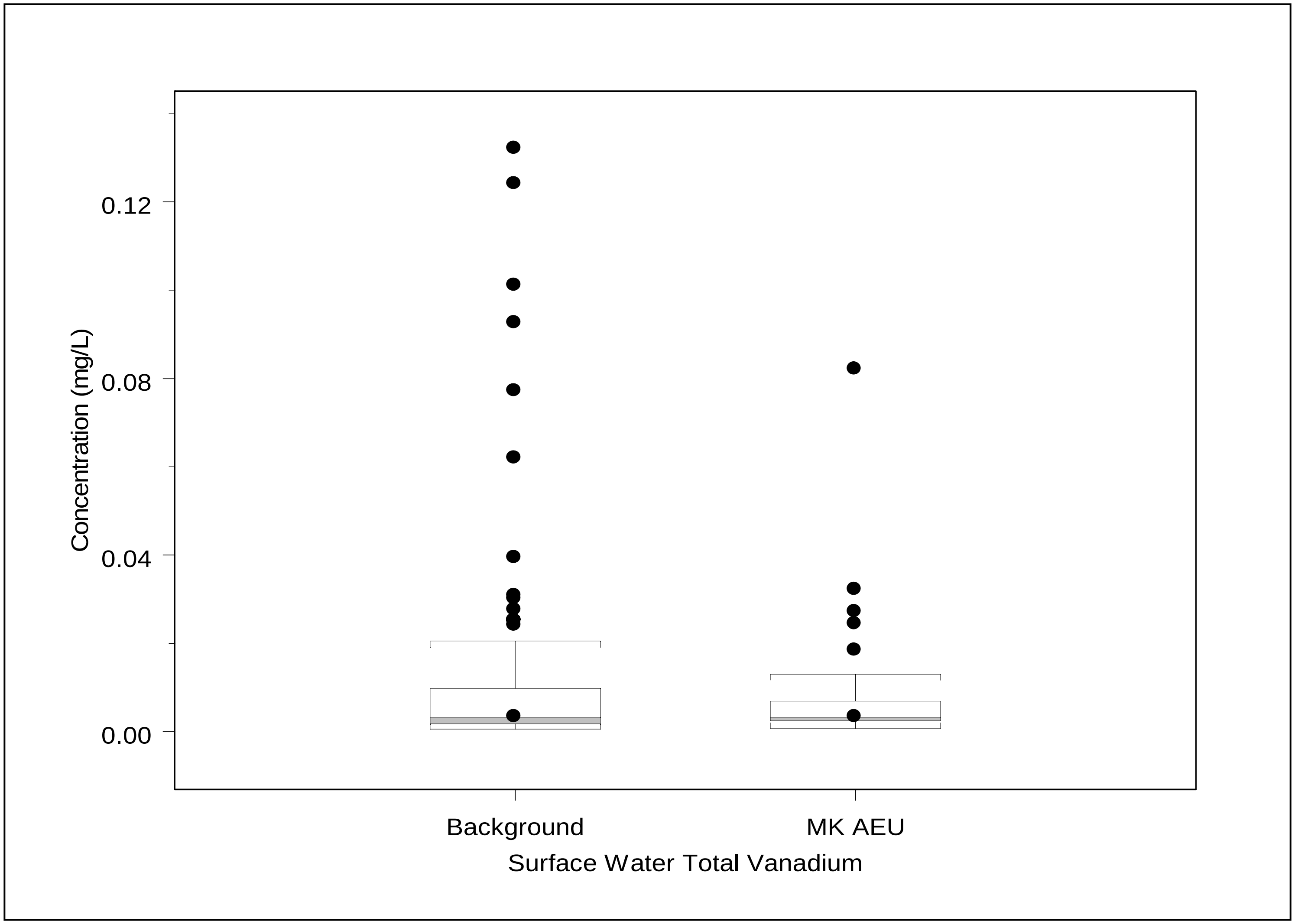
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.7
MK AEU Surface Water Total Box Plots for Silver



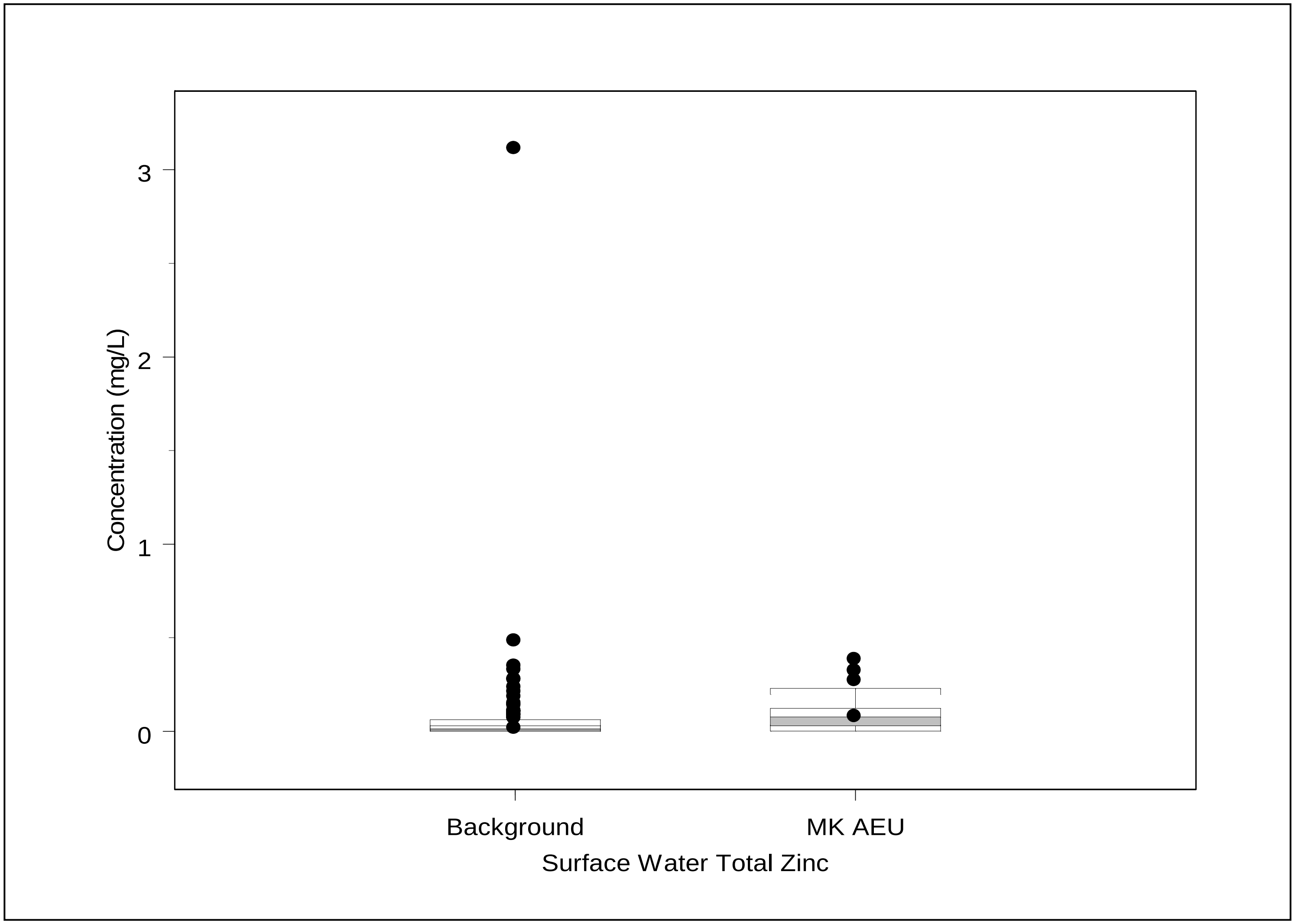
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.8
MK AEU Surface Water Total Box Plots for Vanadium



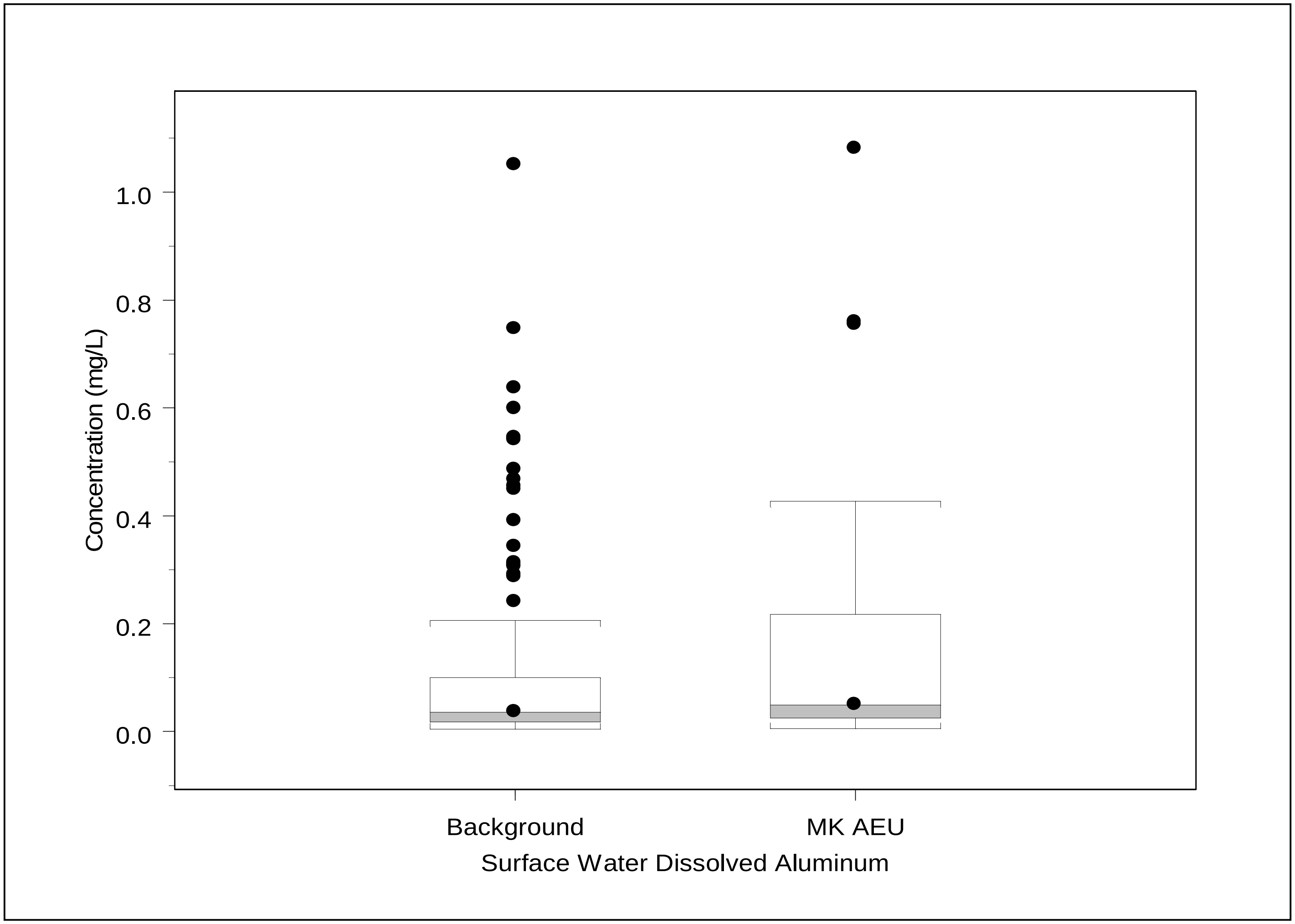
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.9
MK AEU Surface Water Total Box Plots for Zinc



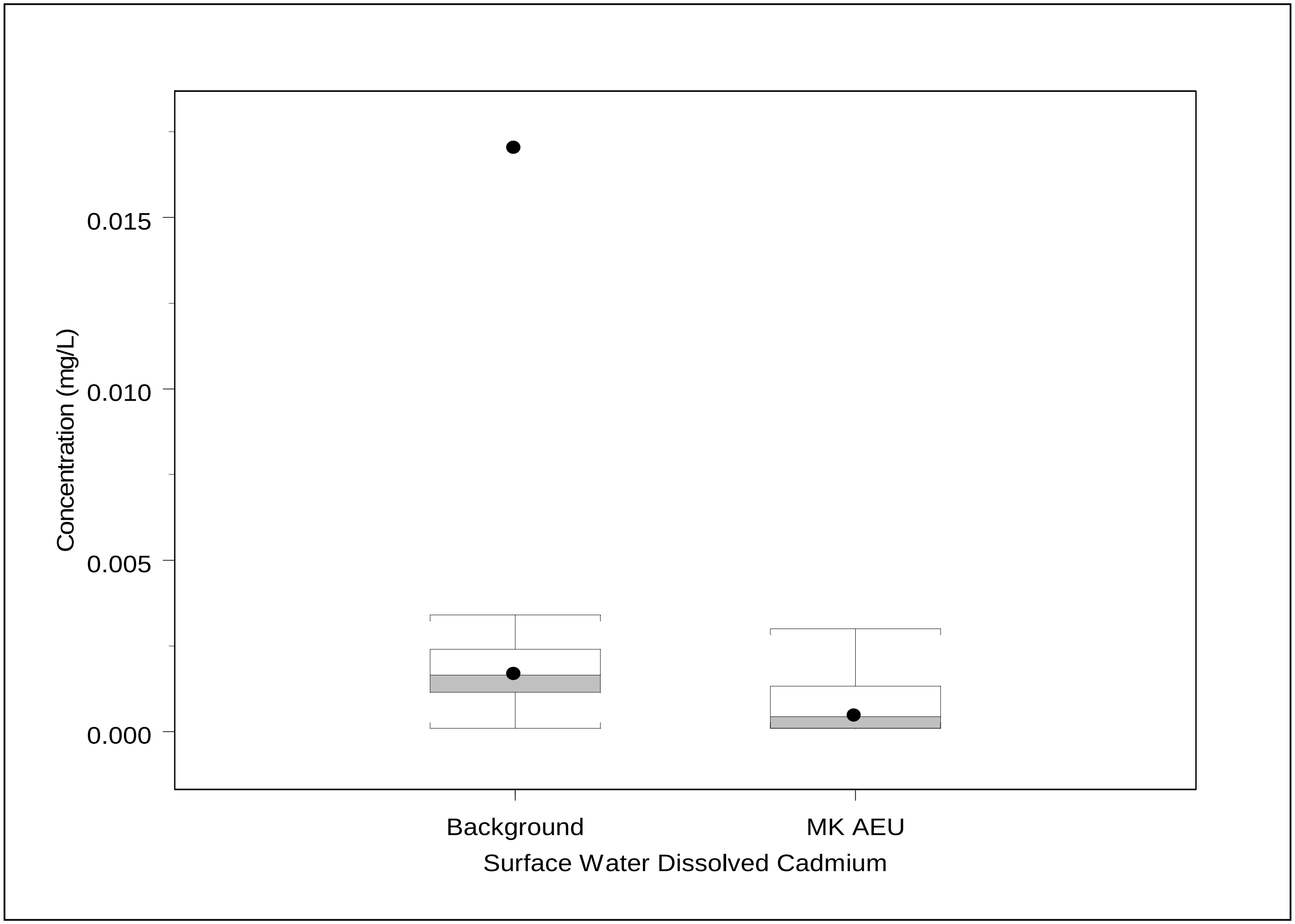
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.10
MK AEU Surface Water Dissolved Box Plots for Aluminum



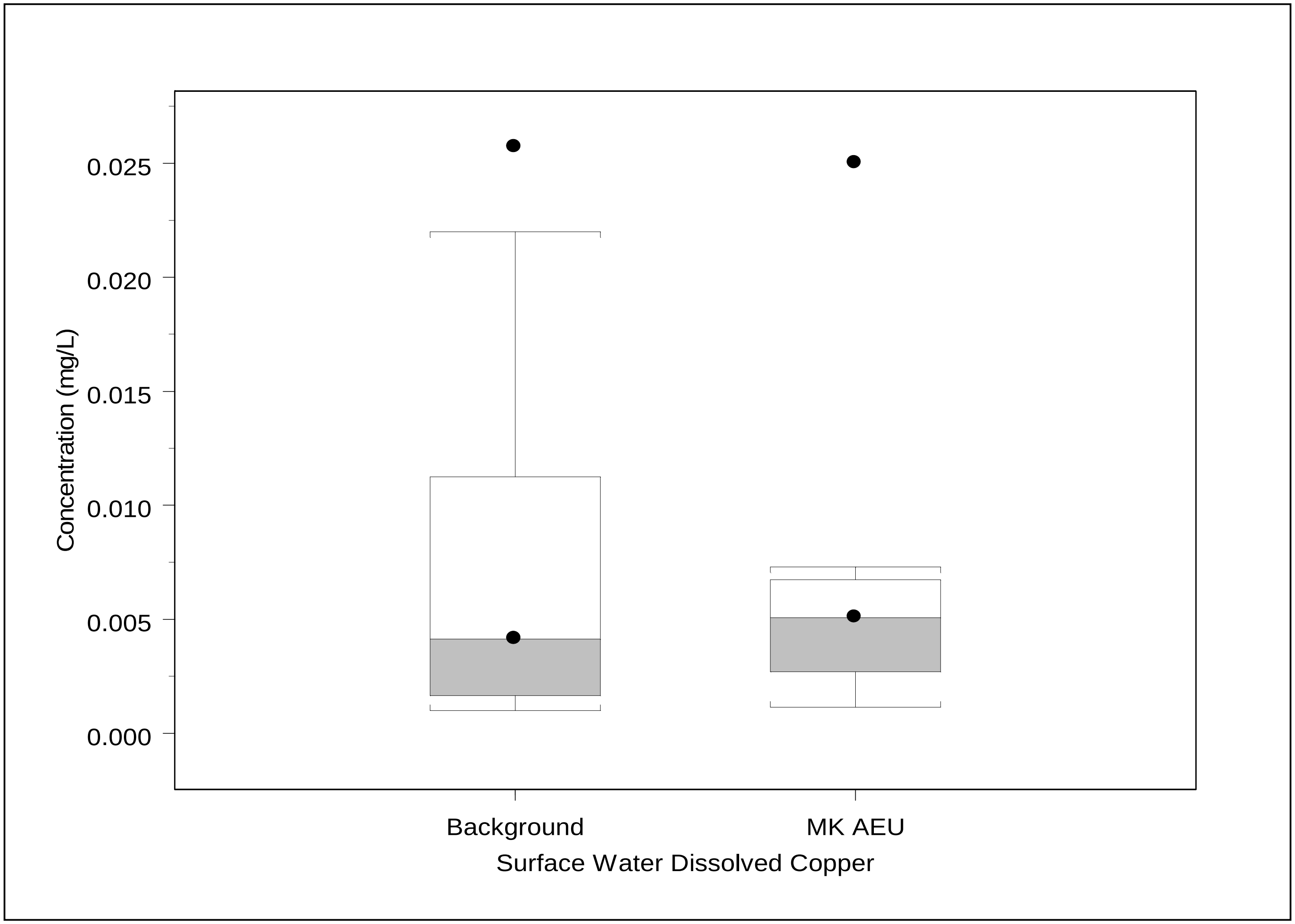
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.11
MK AEU Surface Water Dissolved Box Plots for Cadmium



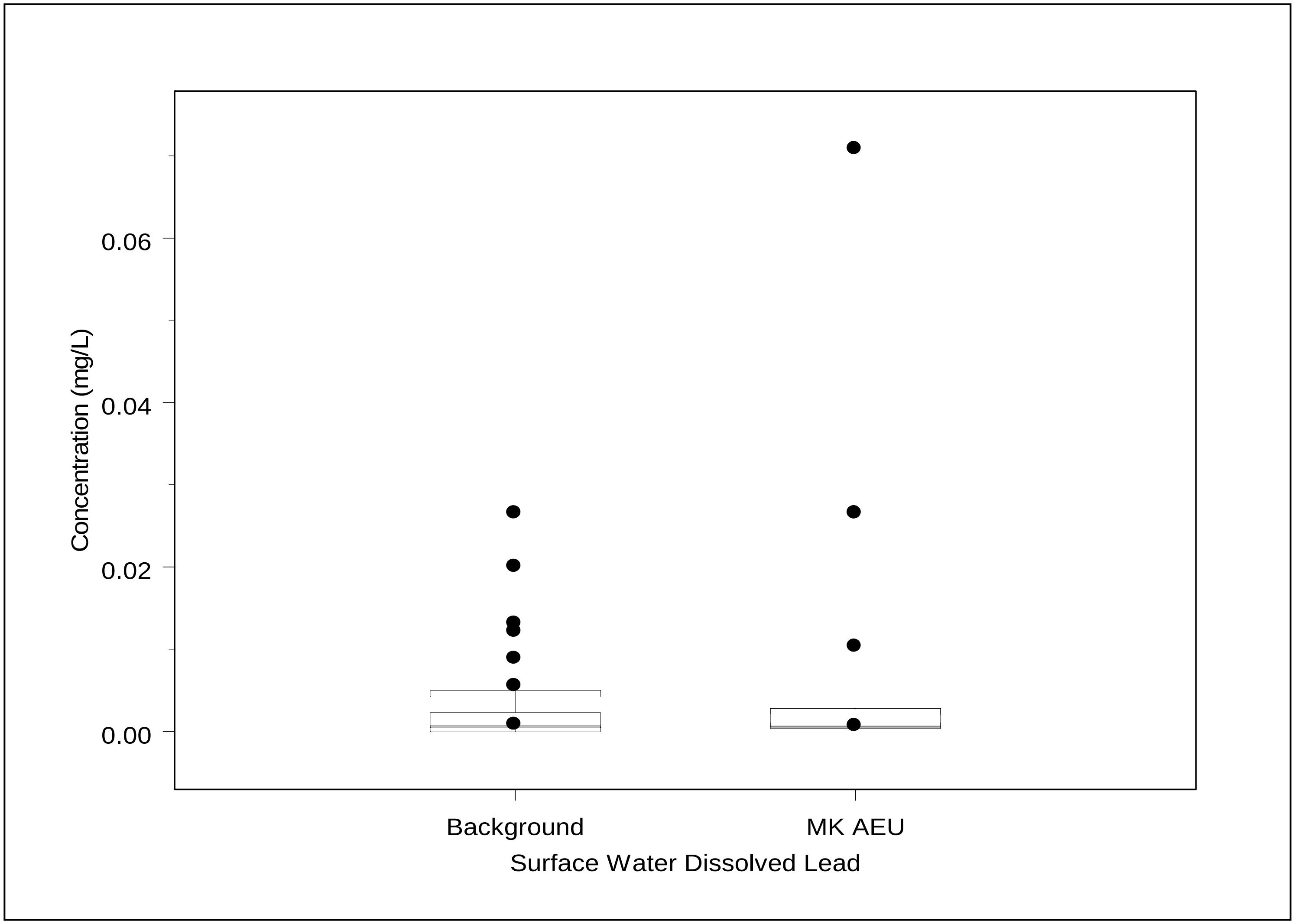
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.12
MK AEU Surface Water Dissolved Box Plots for Copper



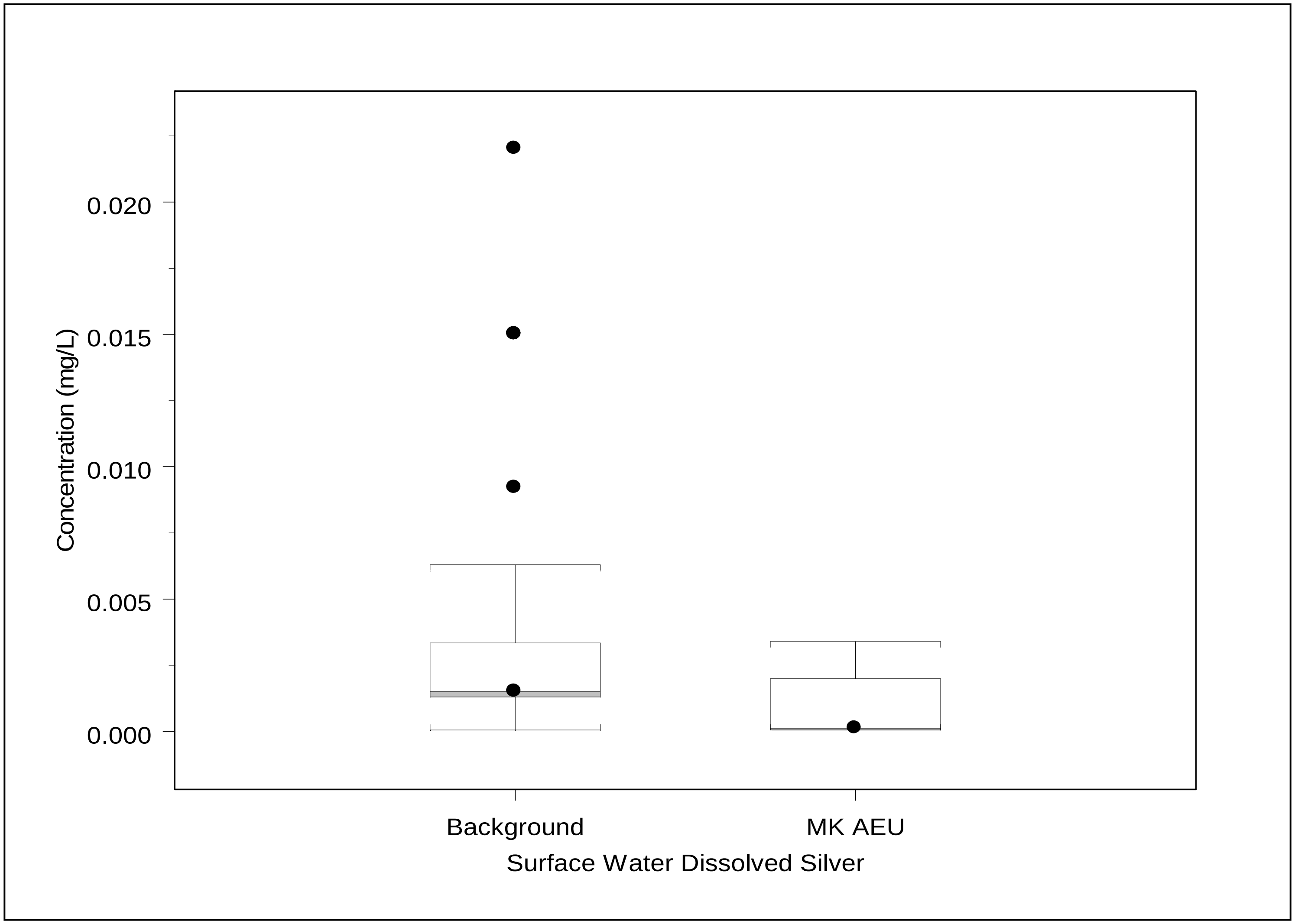
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.13
MK AEU Surface Water Dissolved Box Plots for Lead



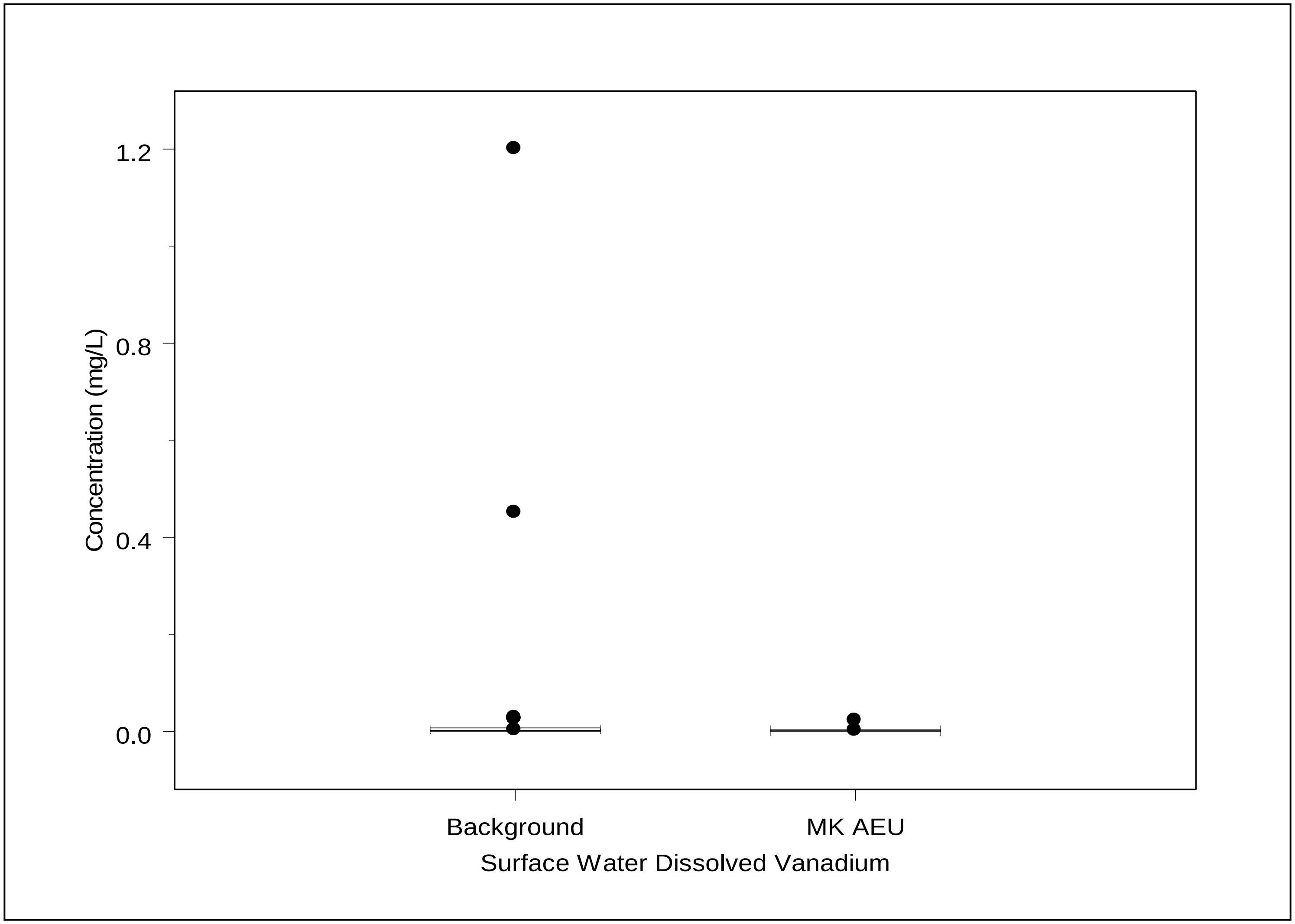
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.14
MK AEU Surface Water Dissolved Box Plots for Silver



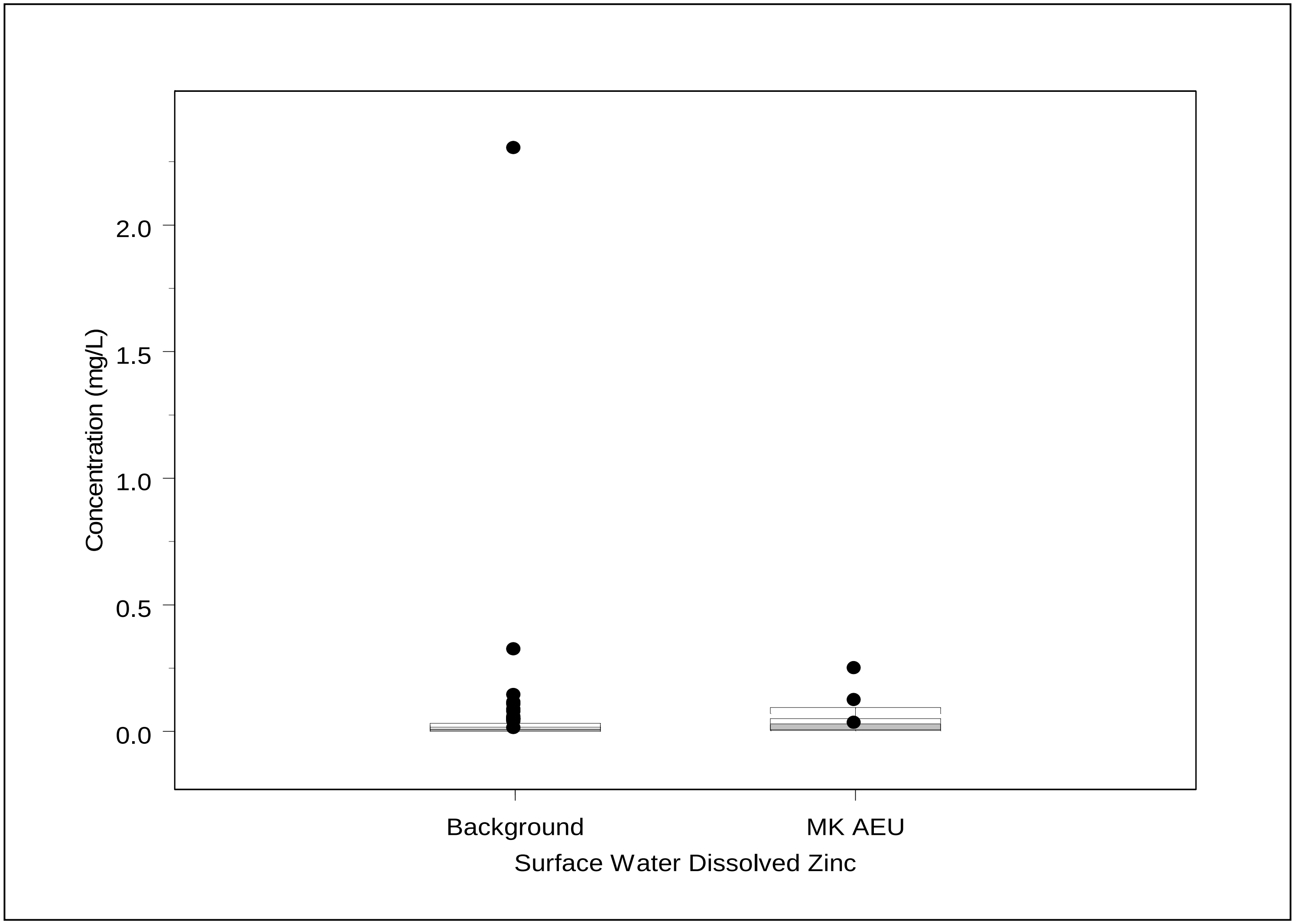
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.15
MK AEU Surface Water Dissolved Box Plots for Vanadium



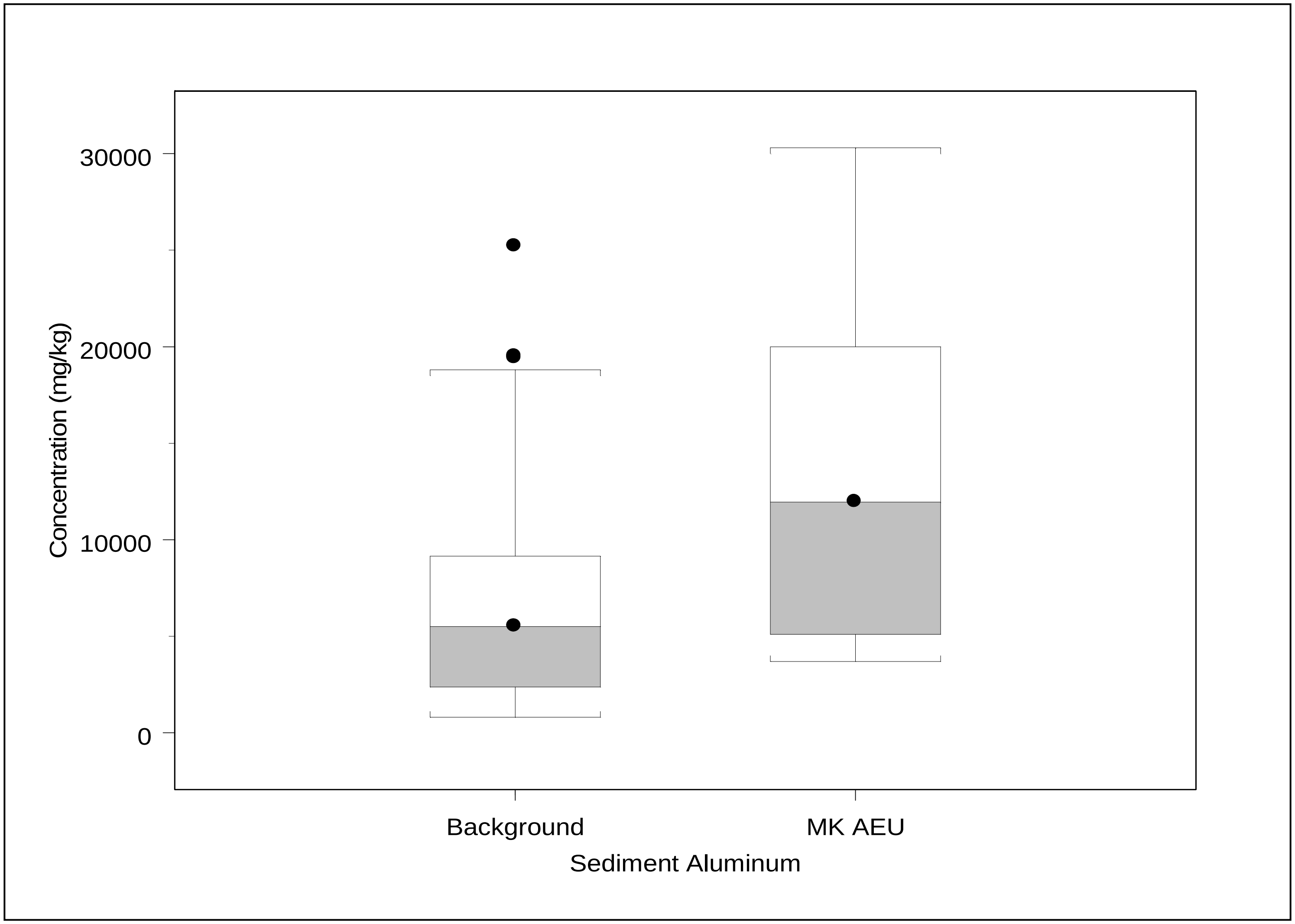
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.16
MK AEU Surface Water Dissolved Box Plots for Zinc



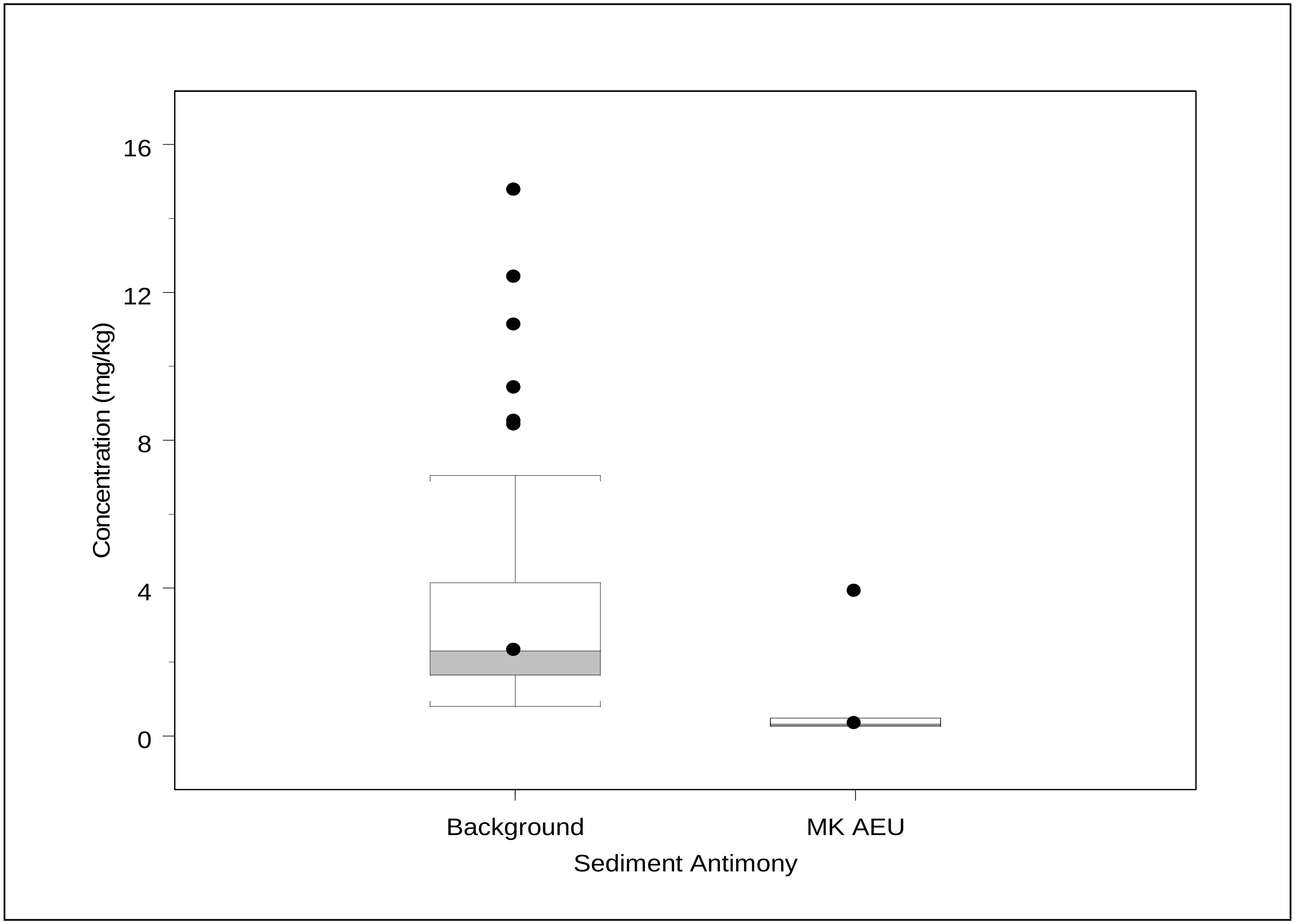
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.17
MK AEU Sediment Box Plots for Aluminum



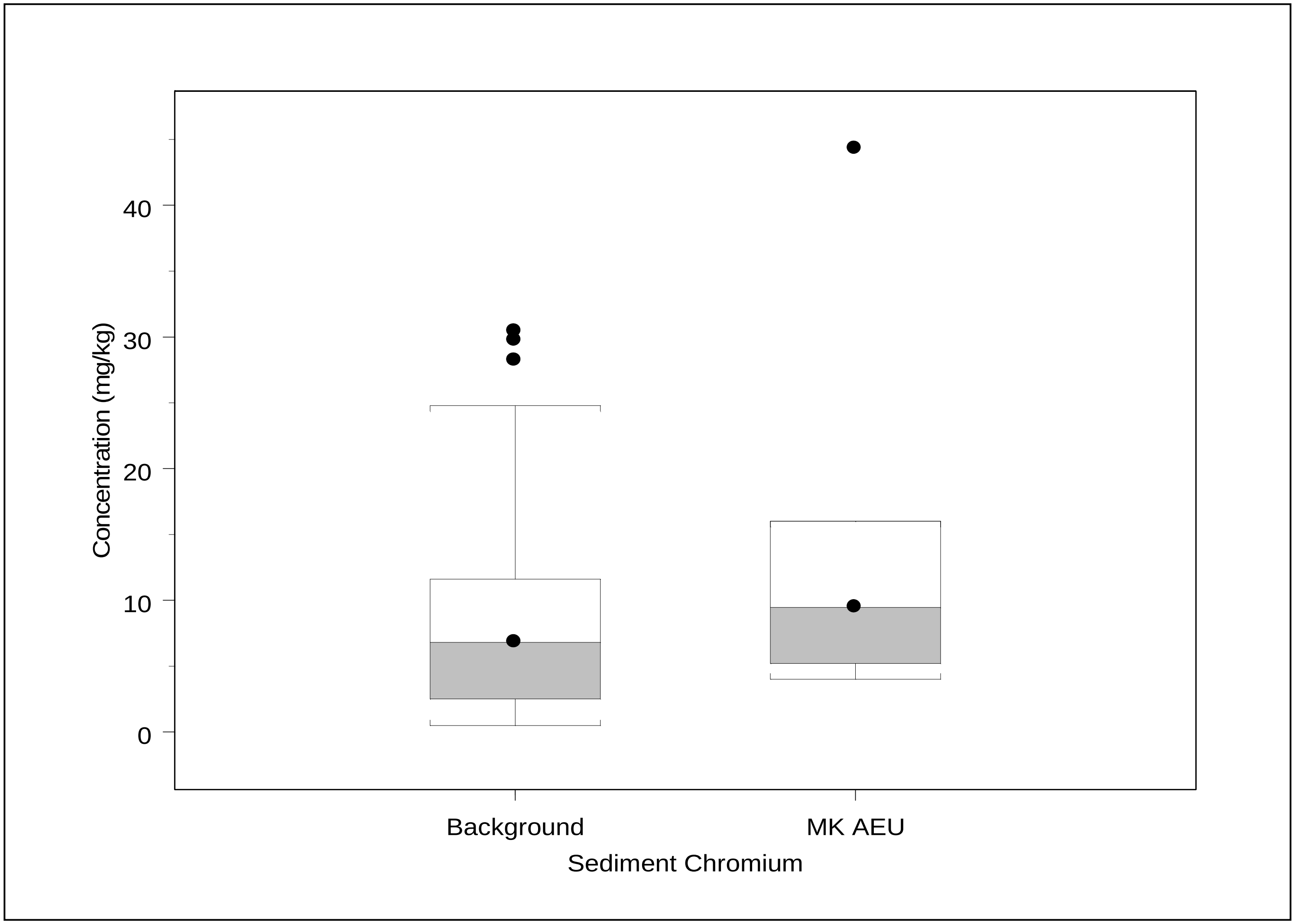
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.18
MK AEU Sediment Box Plots for Antimony



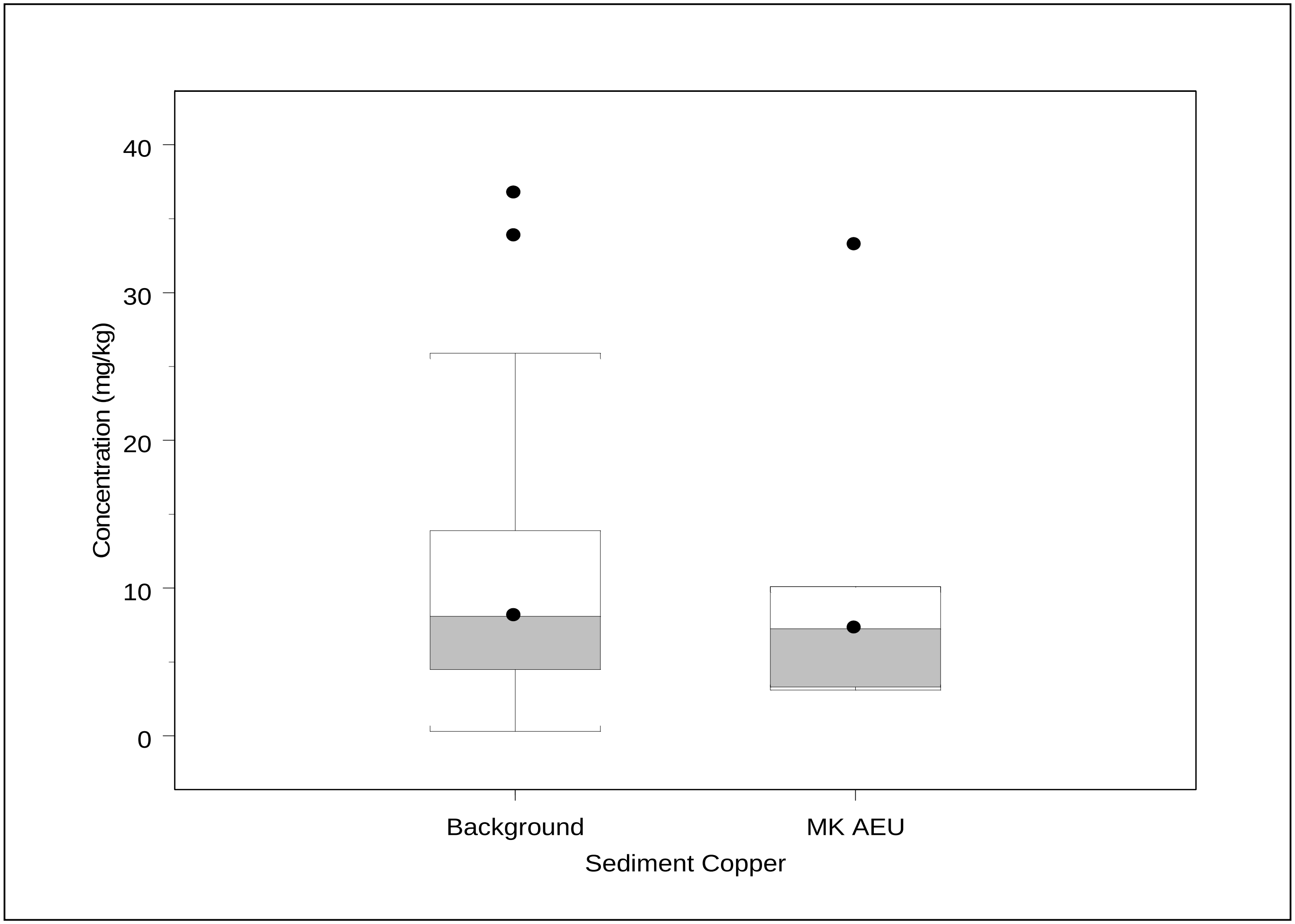
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.19
MK AEU Sediment Box Plots for Chromium



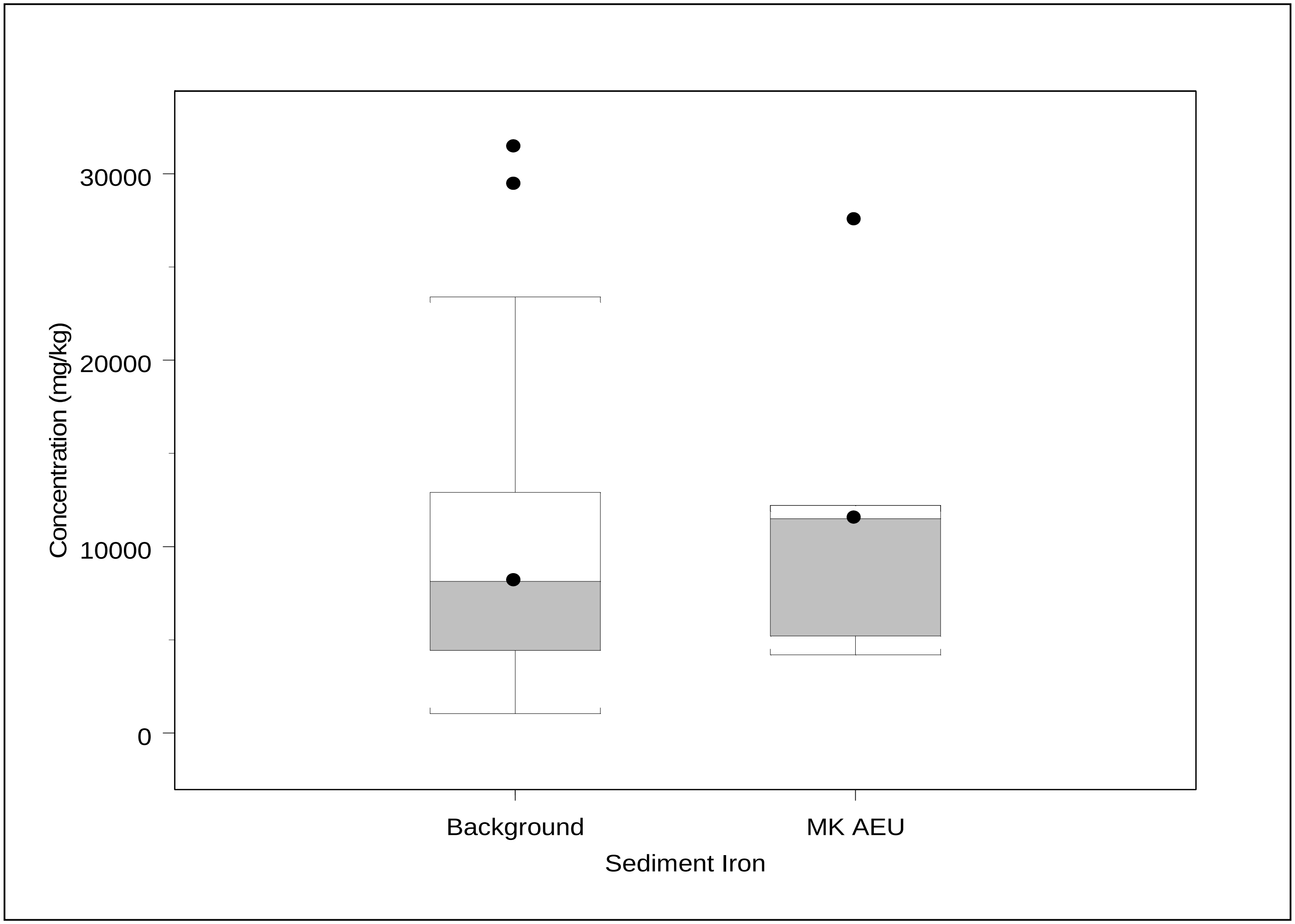
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.20
MK AEU Sediment Box Plots for Copper



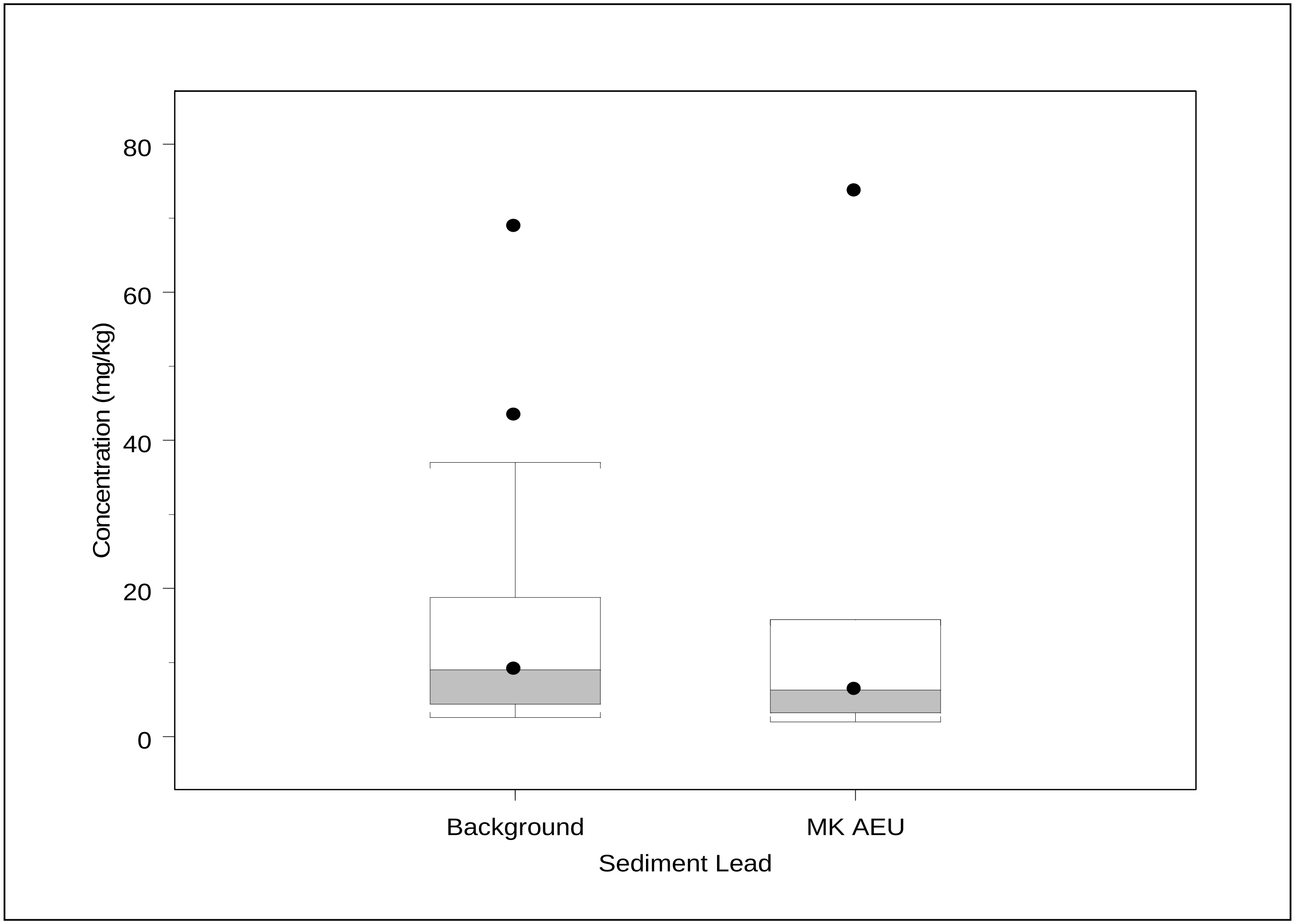
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.21
MK AEU Sediment Box Plots for Iron



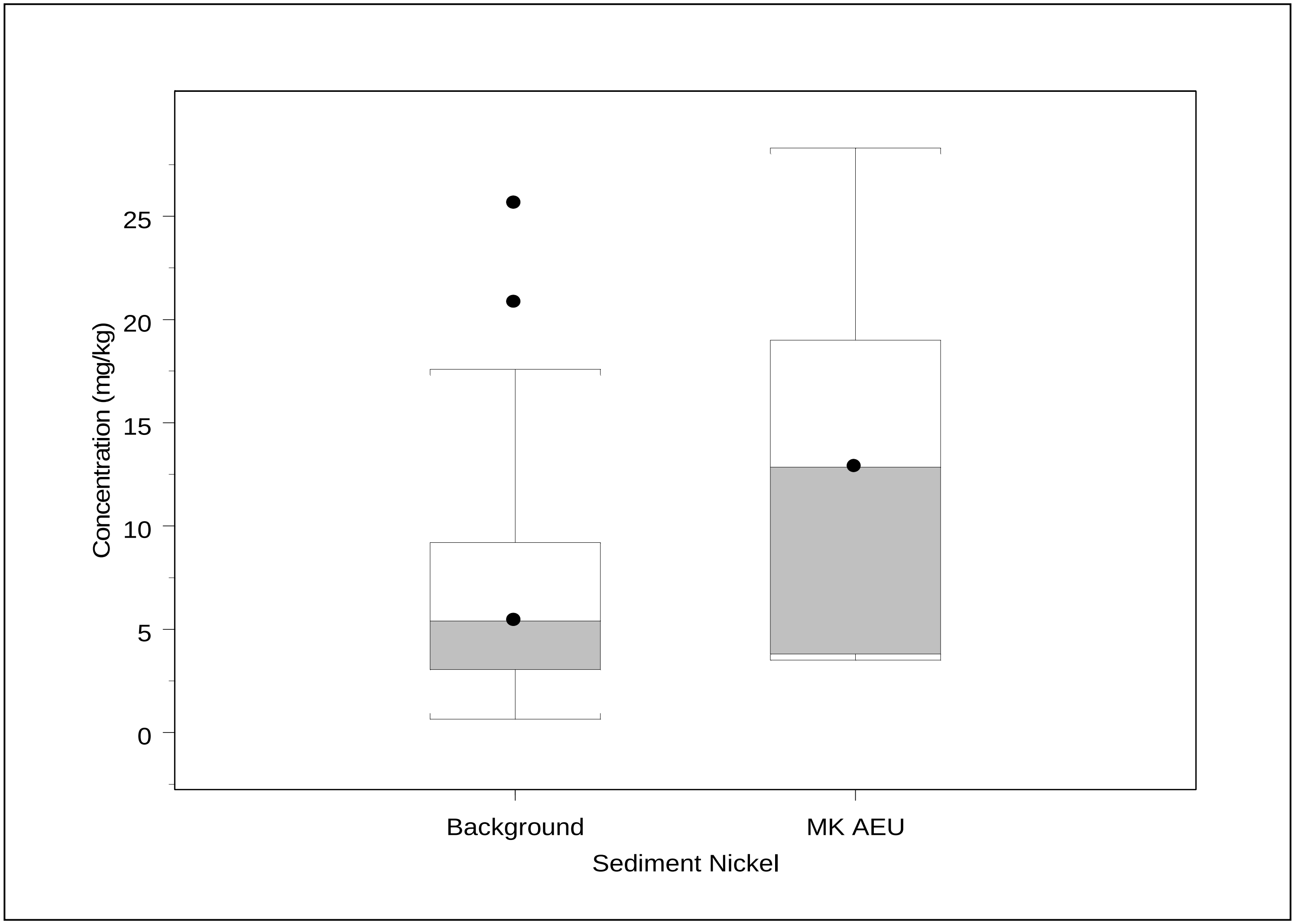
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.22
MK AEU Sediment Box Plots for Lead



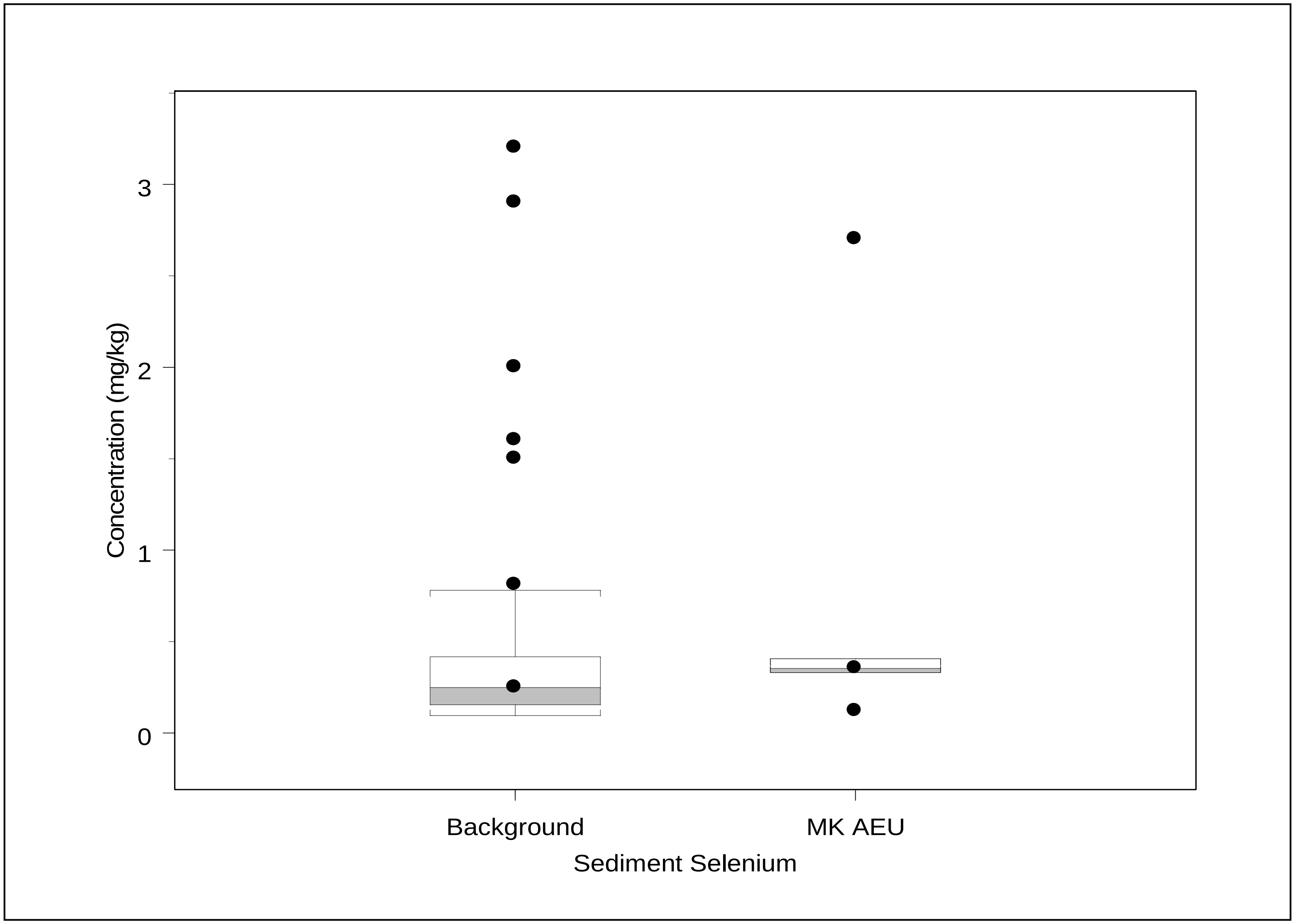
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.23
MK AEU Sediment Box Plots for Nickel



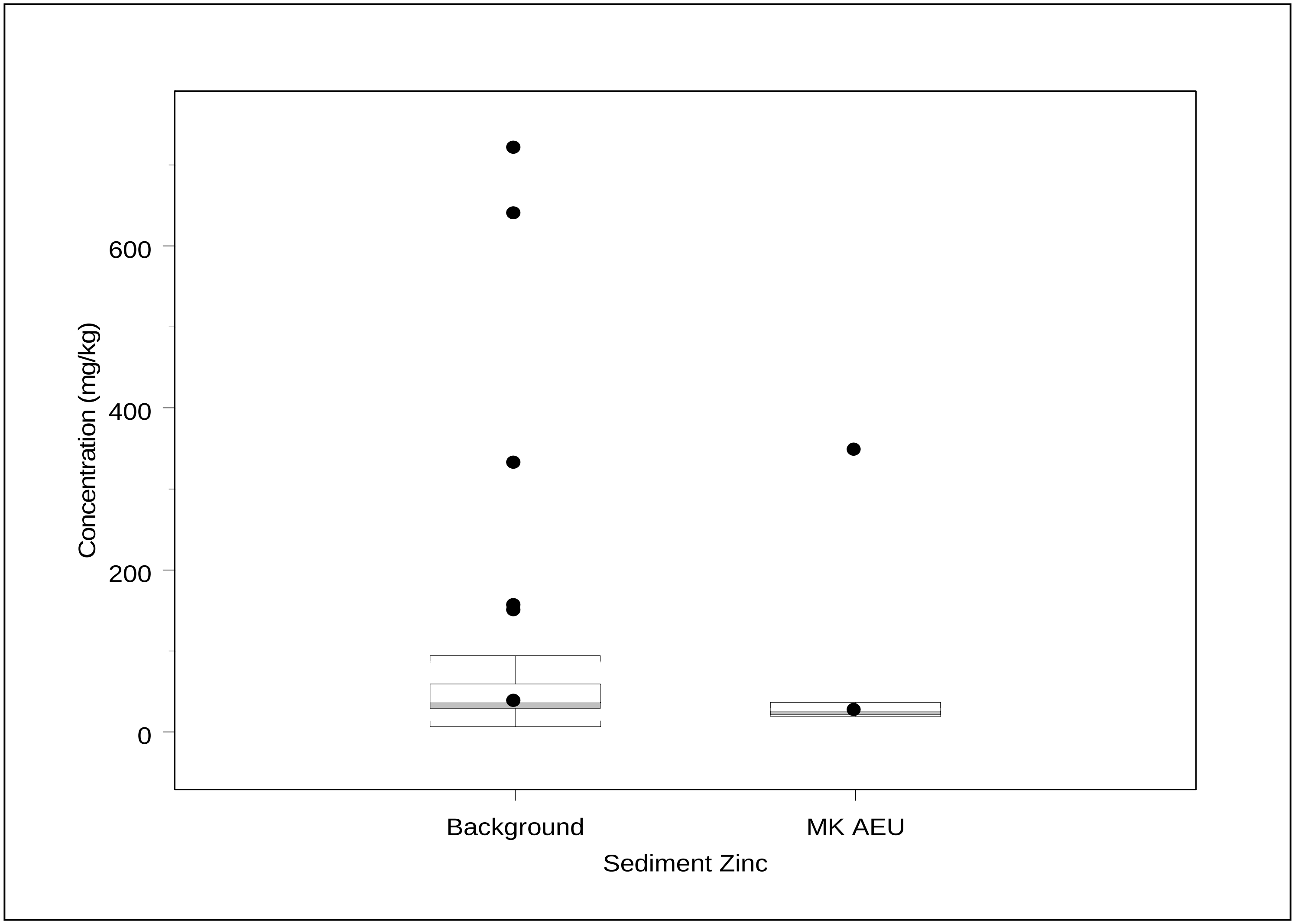
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.24
MK AEU Sediment Box Plots for Selenium



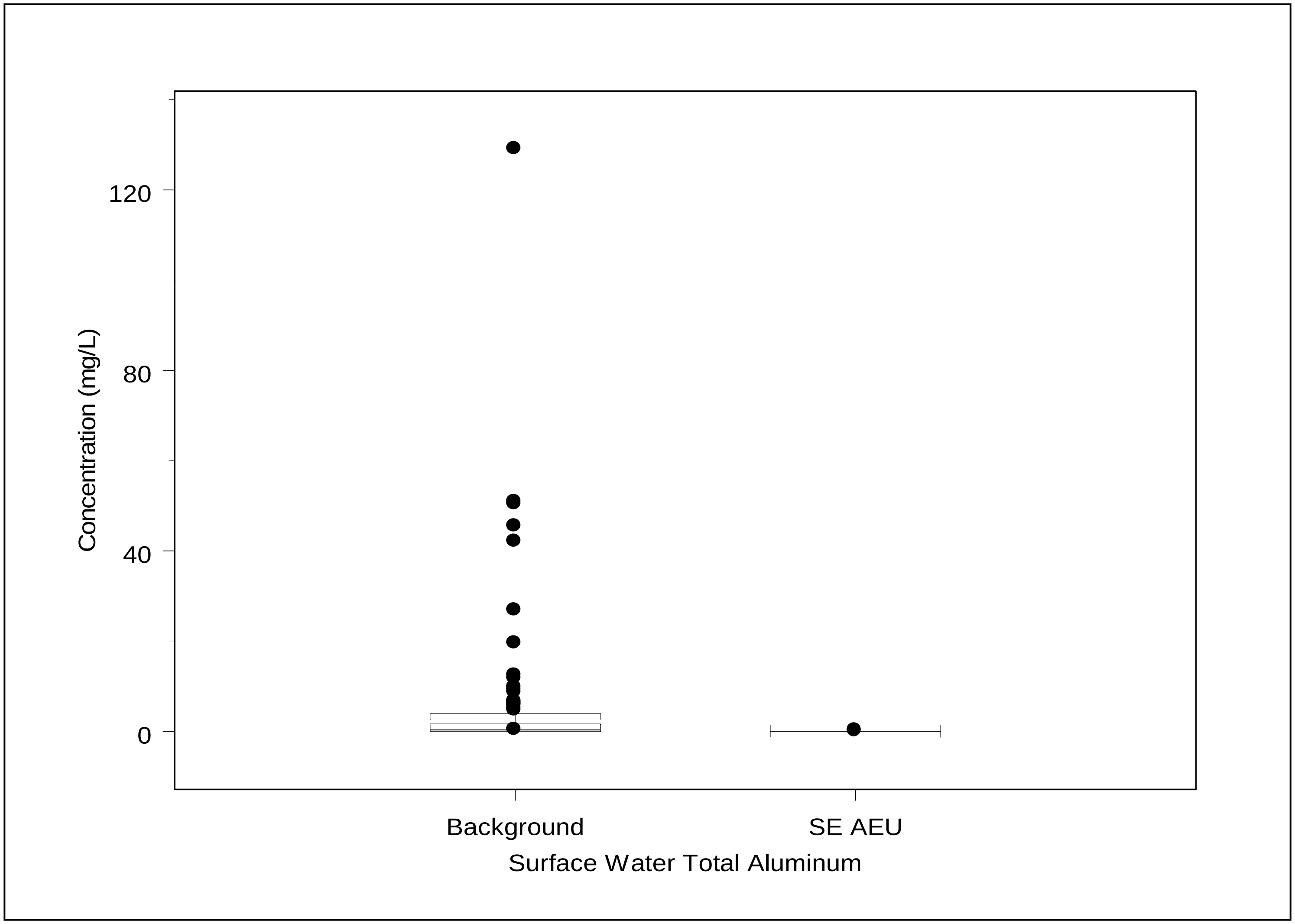
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.MK AEU.25
MK AEU Sediment Box Plots for Zinc



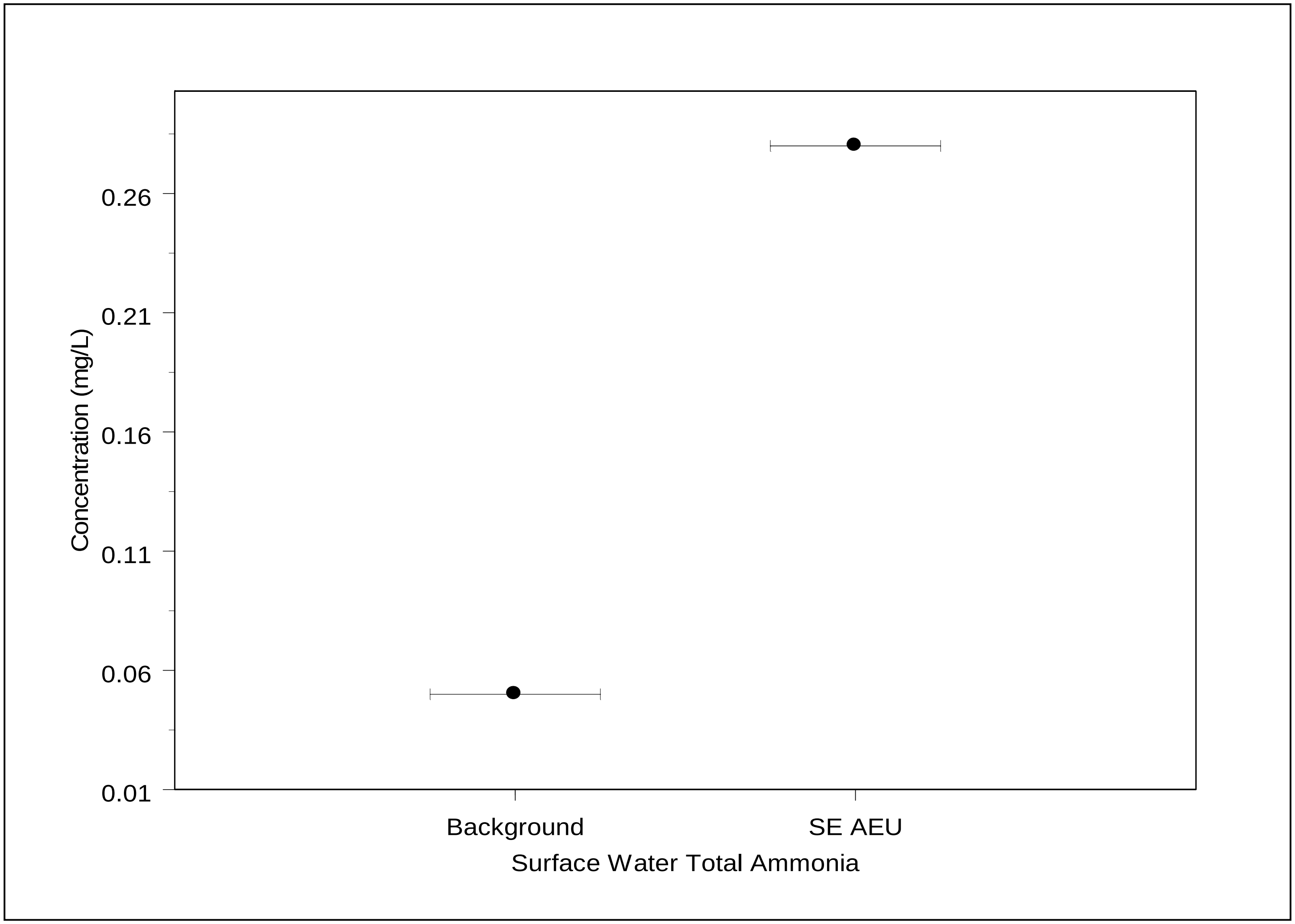
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.SE AEU.1
SE AEU Surface Water Total Box Plots for Aluminum



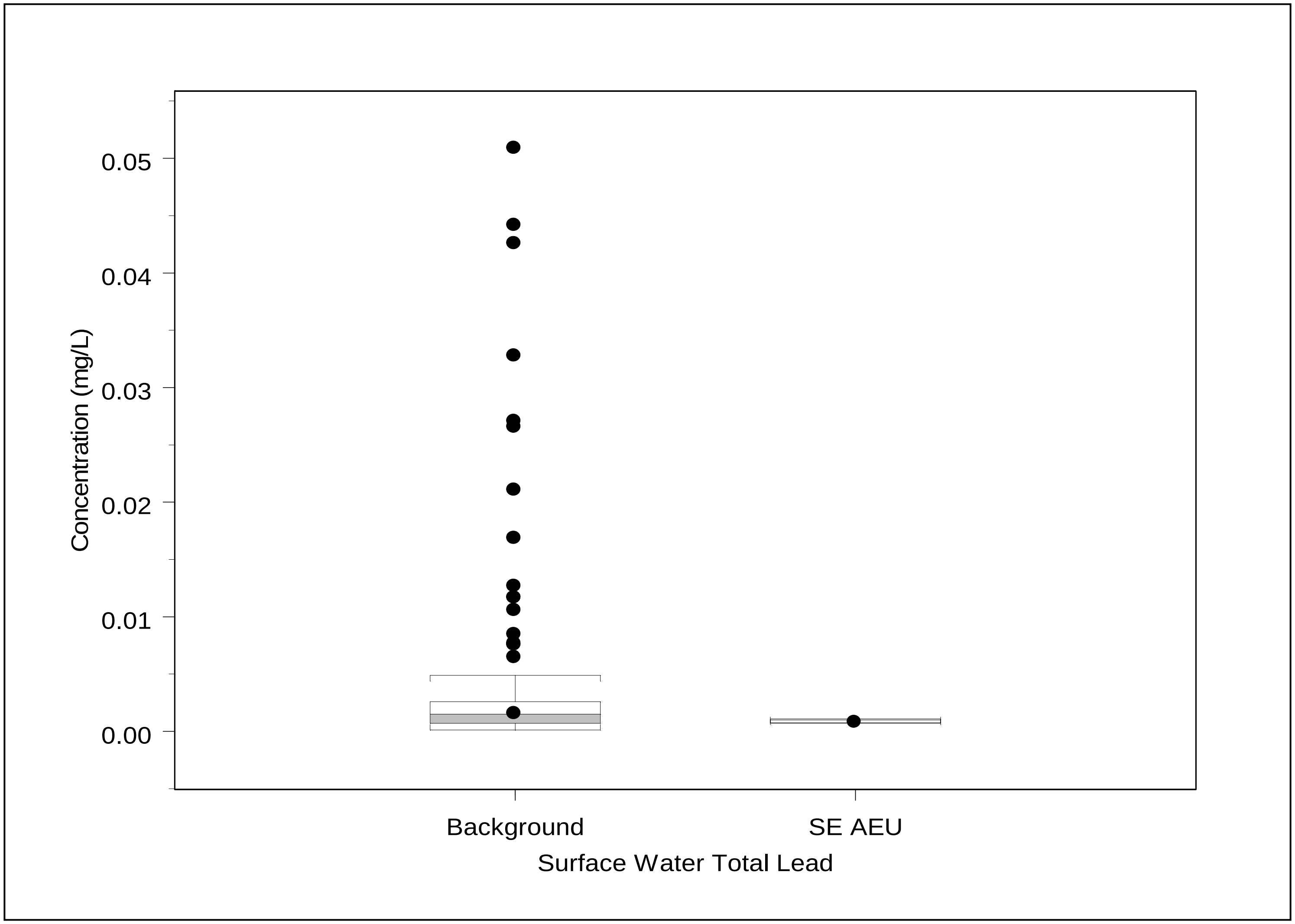
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.SE AEU.2
SE AEU Surface Water Total Box Plots for Ammonia



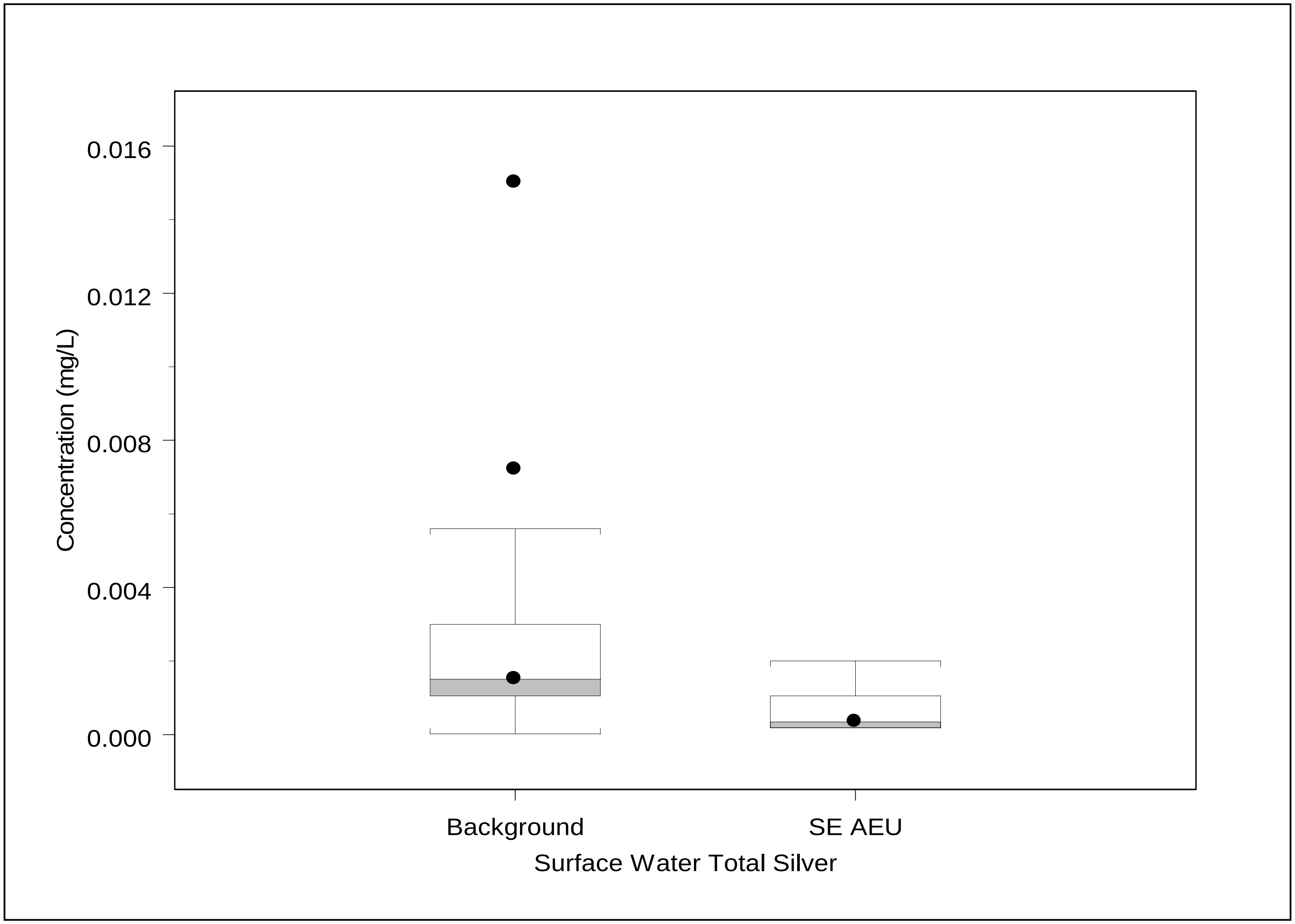
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.SE AEU.3
SE AEU Surface Water Total Box Plots for Lead



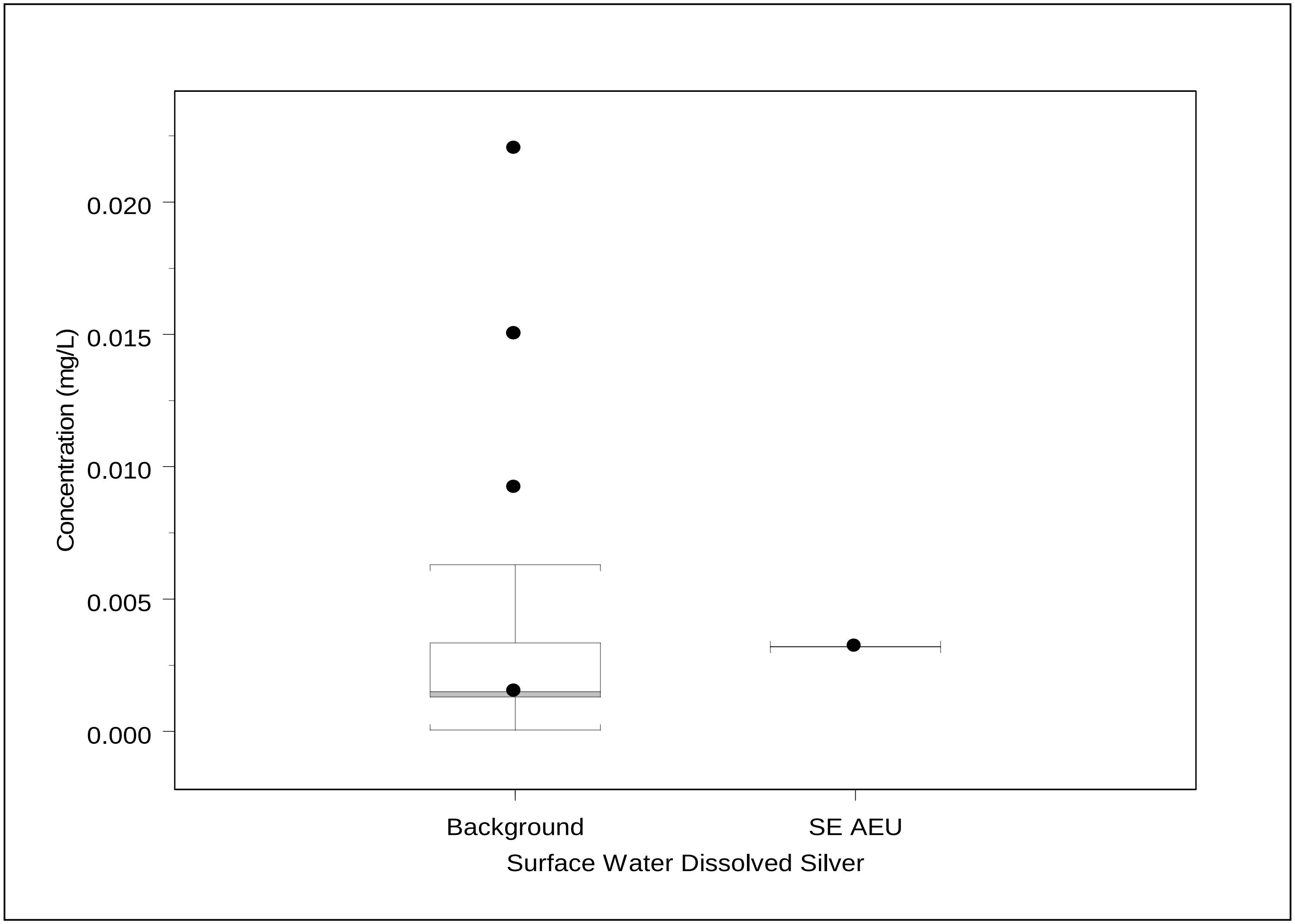
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.SE AEU.4
SE AEU Surface Water Total Box Plots for Silver



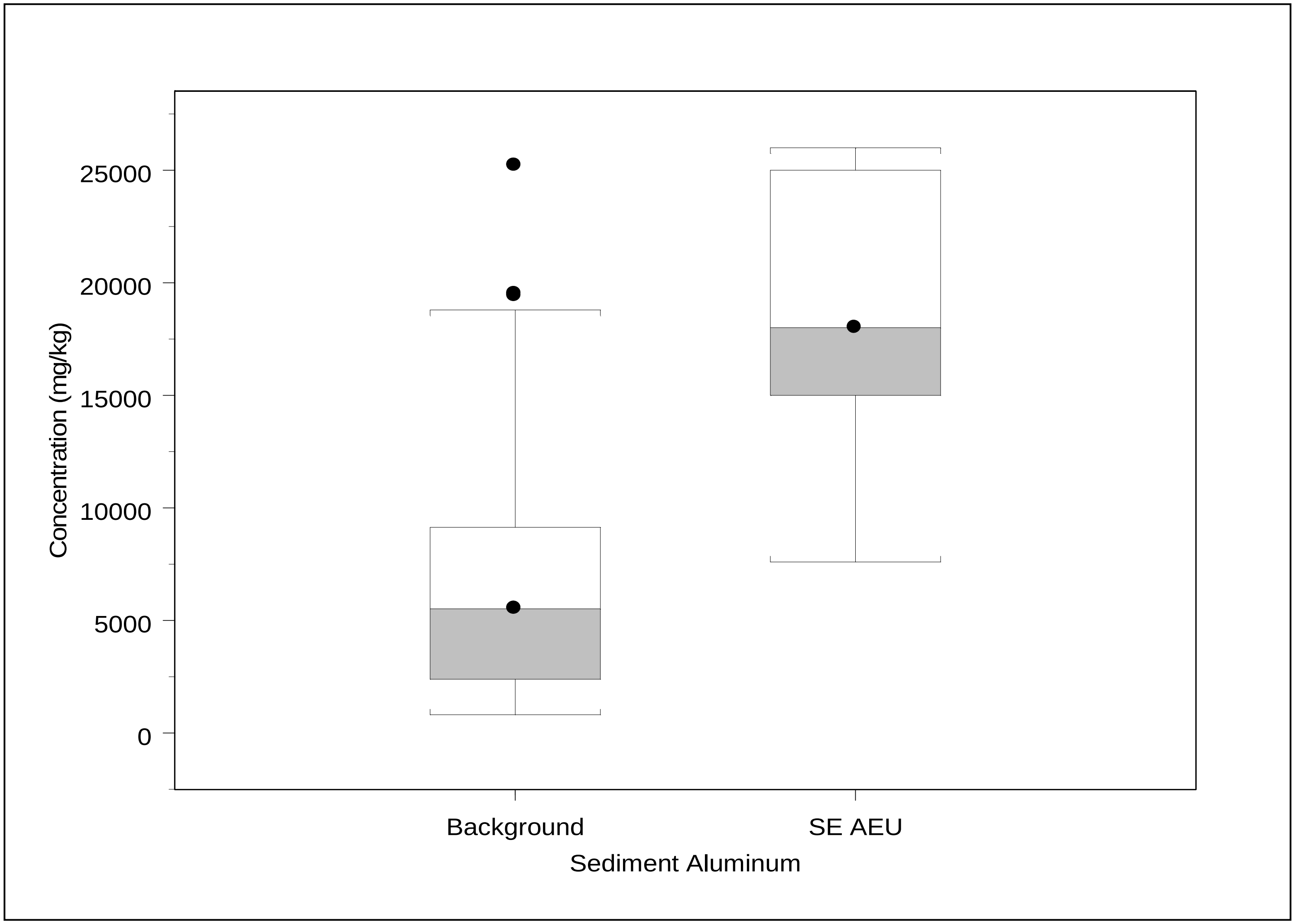
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.SE AEU.5
SE AEU Surface Water Dissolved Box Plots for Silver



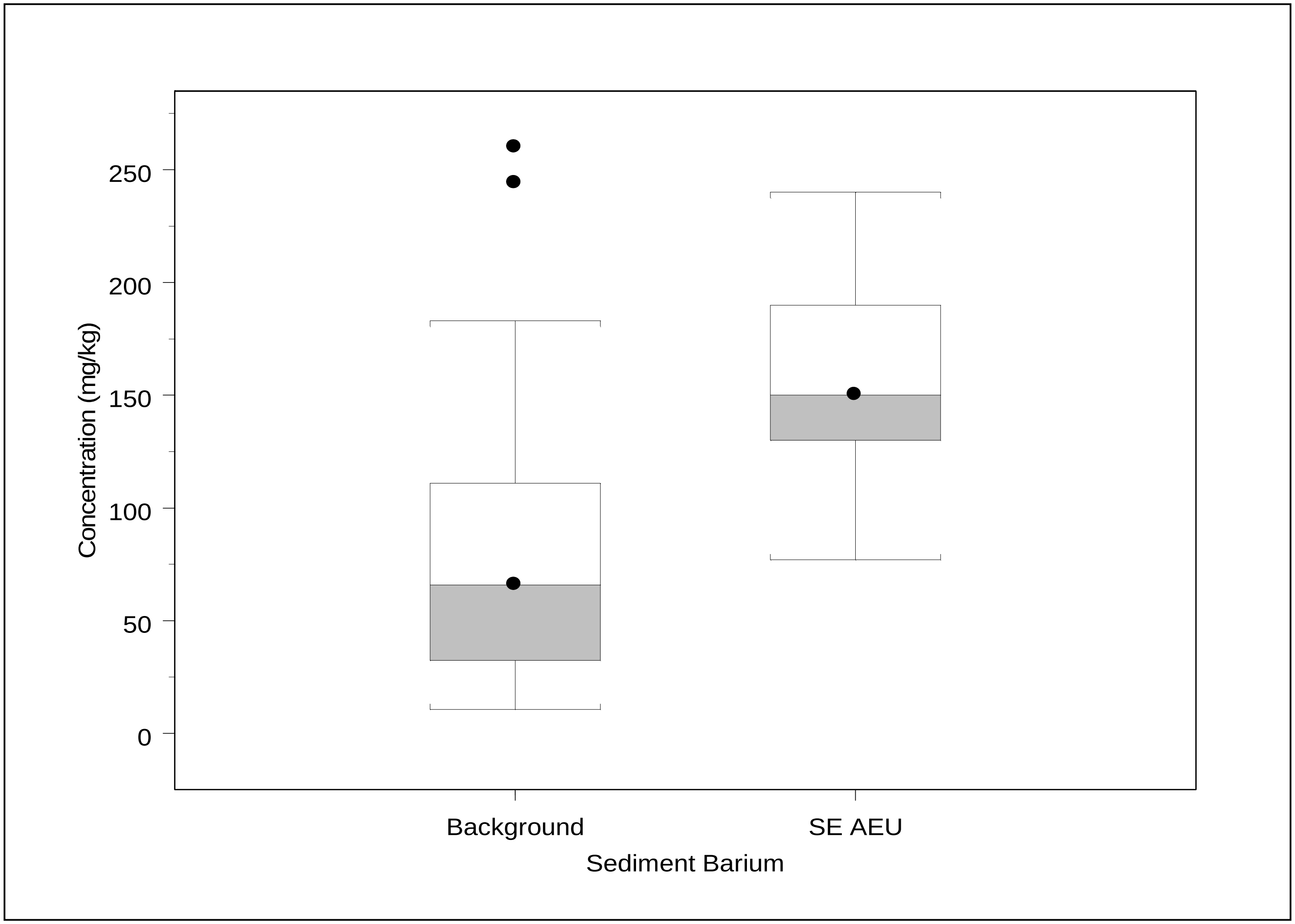
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.SE AEU.6
SE AEU Sediment Box Plots for Aluminum



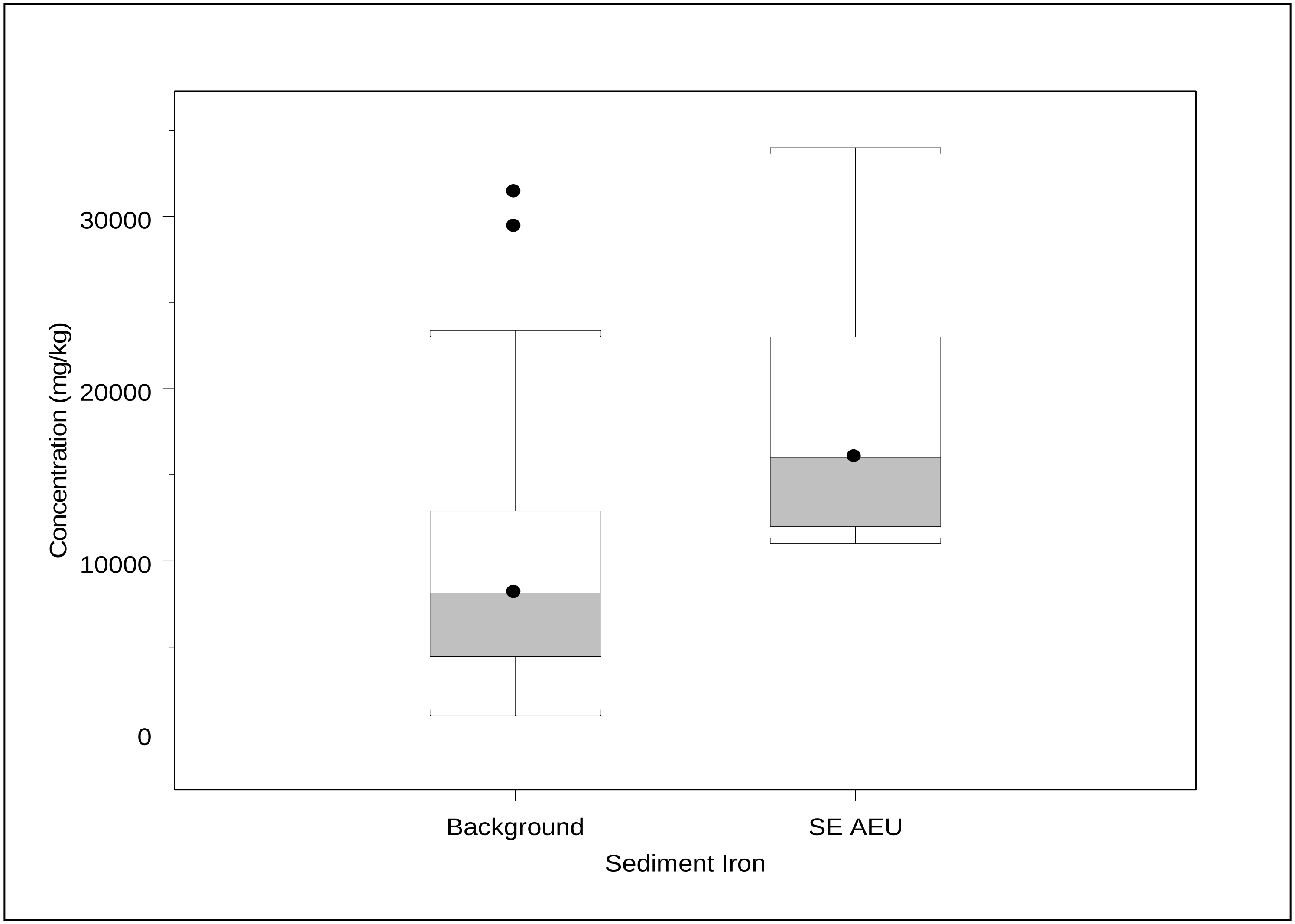
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.SE AEU.7
SE AEU Sediment Box Plots for Barium



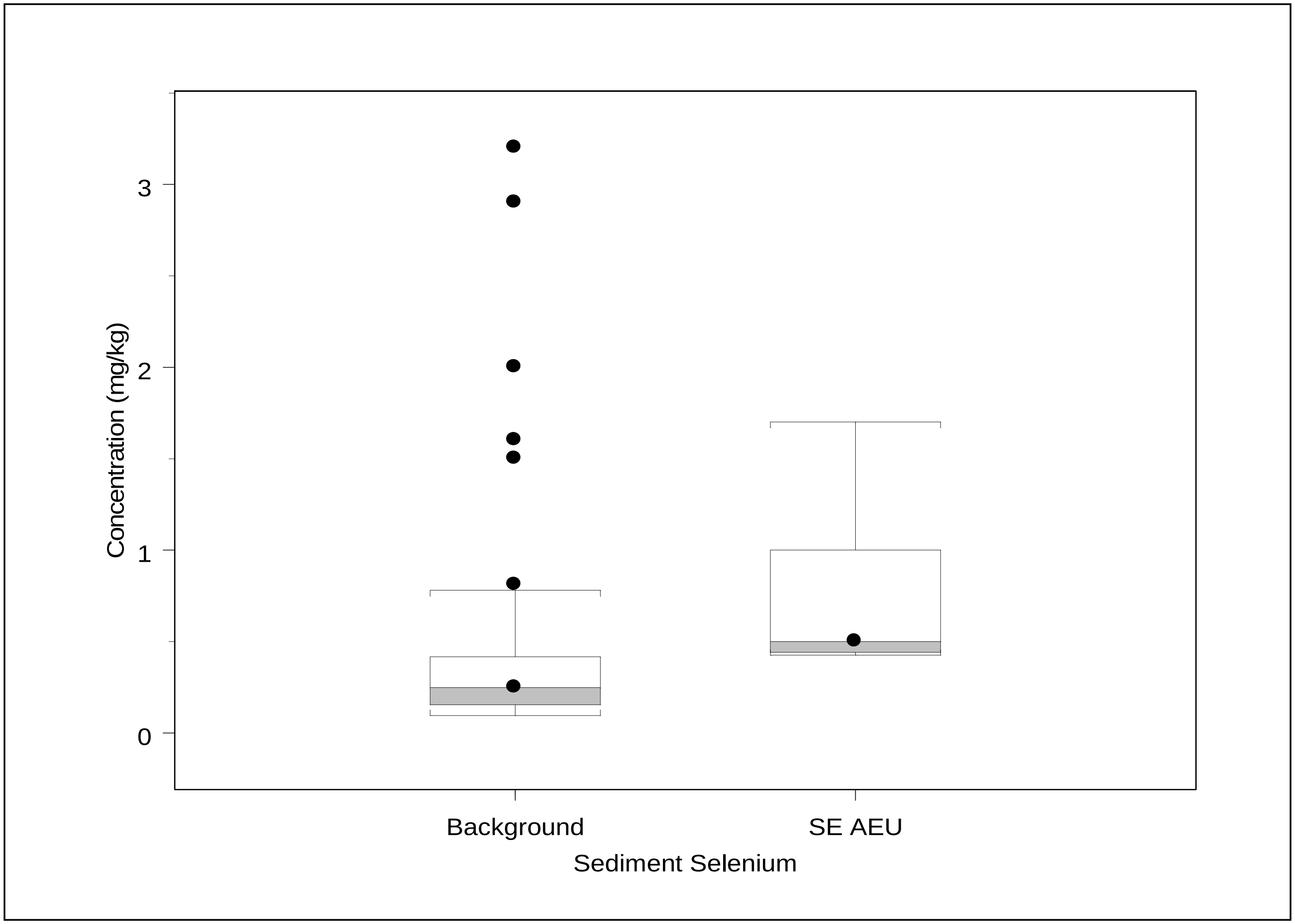
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.SE AEU.8
SE AEU Sediment Box Plots for Iron



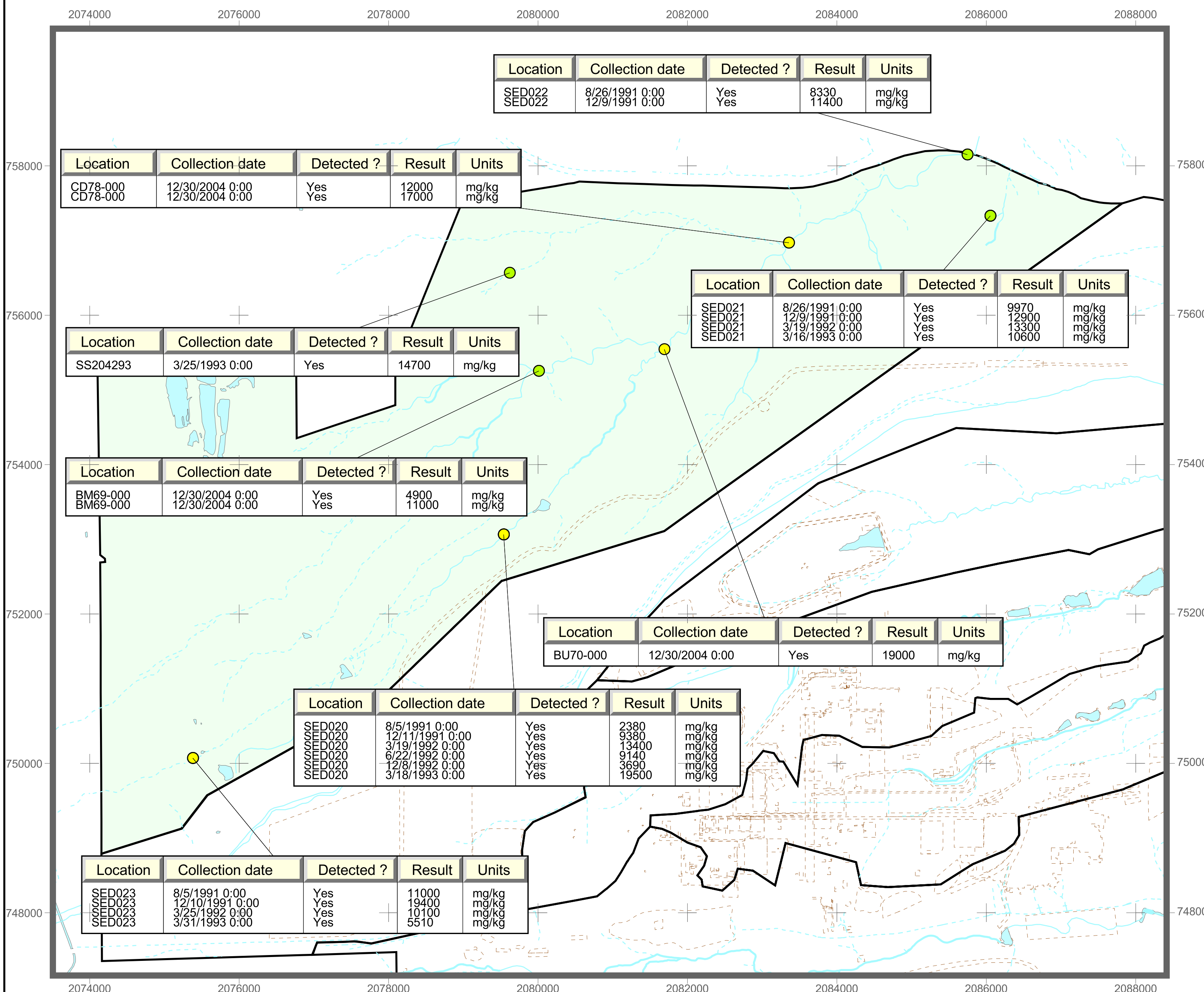
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.SE AEU.9
SE AEU Sediment Box Plots for Selenium



Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.4.RC AEU.1
Rock Creek AEU
Sediment Sampling Locations
for Aluminum



KEY

Sampling location

- Detect >= ESL >= Maximum background
- Detect >=ESL < Maximum Background
- Detect < ESL < Maximum Background
- Nondetect

ESL = 15900 mg/kg

Maximum background = 25200 mg/kg

Standard Map Features

- Rock Creek AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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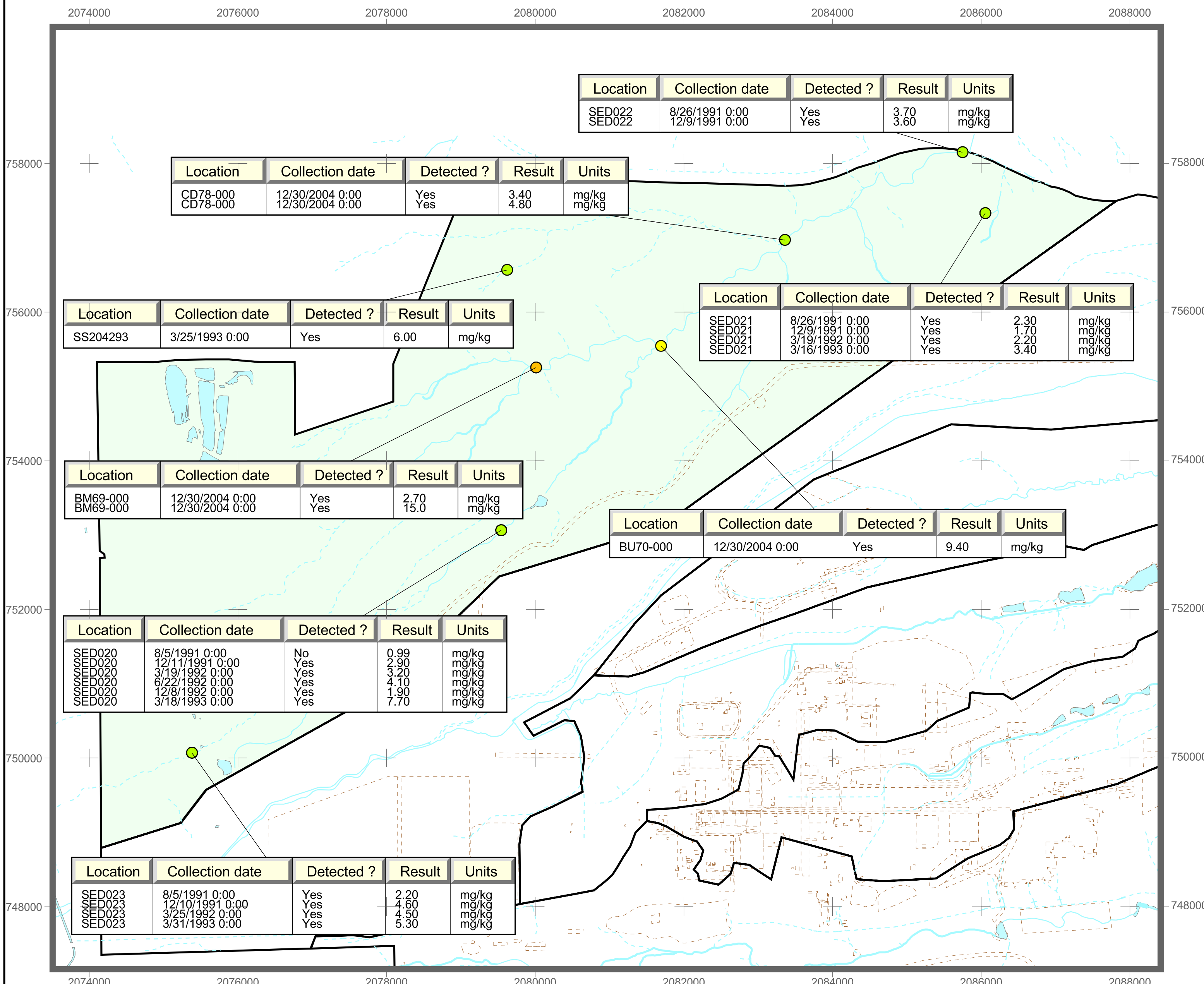

Figure A3.4.RC AEU.2
Rock Creek AEU
Sediment Sampling Locations for Arsenic

KEY

Sampling location

- Detect >= ESL >= Maximum background
- Detect >=Maximum Background < ESL
- Detect < ESL < Maximum Background
- Nondetect

ESL = 9.79 mg/kg

Maximum background = 8.7 mg/kg

Standard Map Features

- Rock Creek AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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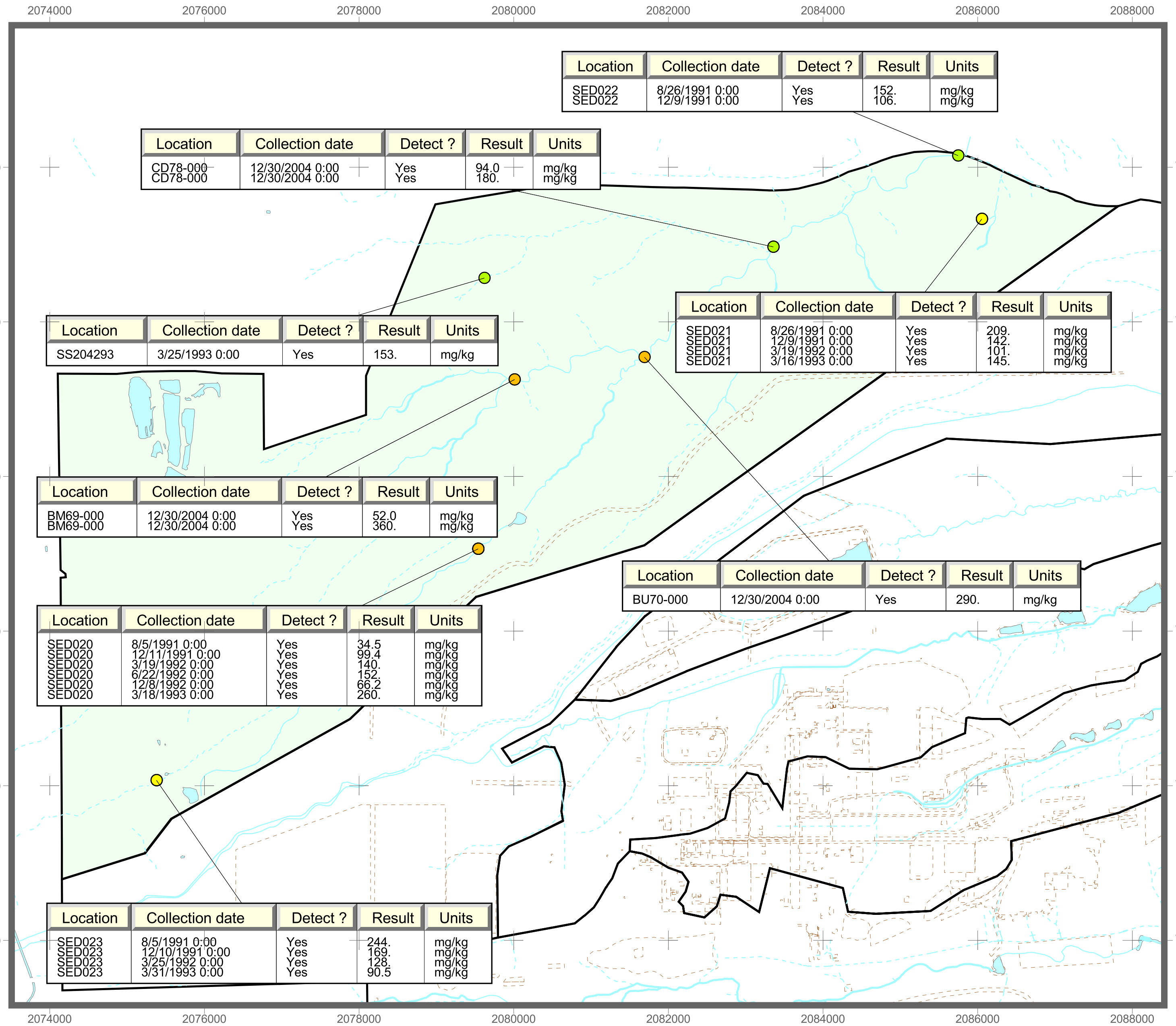
Figure A3.4.RC AEU.3
Rock Creek AEU
Sediment Sampling Locations for Barium



Location	Collection date	Detect ?	Result	Units
SED022	8/26/1991 0:00	Yes	152.	mg/kg
SED022	12/9/1991 0:00	Yes	106.	mg/kg

Location	Collection date	Detect ?	Result	Units
CD78-000	12/30/2004 0:00	Yes	94.0	mg/kg
CD78-000	12/30/2004 0:00	Yes	180.	mg/kg

Location	Collection date	Detect ?	Result	Units
SS204293	3/25/1993 0:00	Yes	153.	mg/kg

Location	Collection date	Detect ?	Result	Units
SED021	8/26/1991 0:00	Yes	209.	mg/kg
SED021	12/9/1991 0:00	Yes	142.	mg/kg
SED021	3/19/1992 0:00	Yes	101.	mg/kg
SED021	3/16/1993 0:00	Yes	145.	mg/kg

Location	Collection date	Detect ?	Result	Units
BM69-000	12/30/2004 0:00	Yes	52.0	mg/kg
BM69-000	12/30/2004 0:00	Yes	360.	mg/kg

Location	Collection date	Detect ?	Result	Units
BU70-000	12/30/2004 0:00	Yes	290.	mg/kg

Location	Collection date	Detect ?	Result	Units
SED020	8/5/1991 0:00	Yes	34.5	mg/kg
SED020	12/11/1991 0:00	Yes	99.4	mg/kg
SED020	3/19/1992 0:00	Yes	140.	mg/kg
SED020	6/22/1992 0:00	Yes	152.	mg/kg
SED020	12/8/1992 0:00	Yes	66.2	mg/kg
SED020	3/18/1993 0:00	Yes	260.	mg/kg

Location	Collection date	Detect ?	Result	Units
SED023	8/5/1991 0:00	Yes	244.	mg/kg
SED023	12/10/1991 0:00	Yes	169.	mg/kg
SED023	3/25/1992 0:00	Yes	128.	mg/kg
SED023	3/31/1993 0:00	Yes	90.5	mg/kg

KEY

Sampling location

- Detect >= ESL >= Maximum background
- Detect >=ESL < Maximum Background
- Detect < ESL < Maximum Background
- Nondetect

ESL = 189 mg/kg

Maximum background = 260 mg/kg

Standard Map Features

- Rock Creek AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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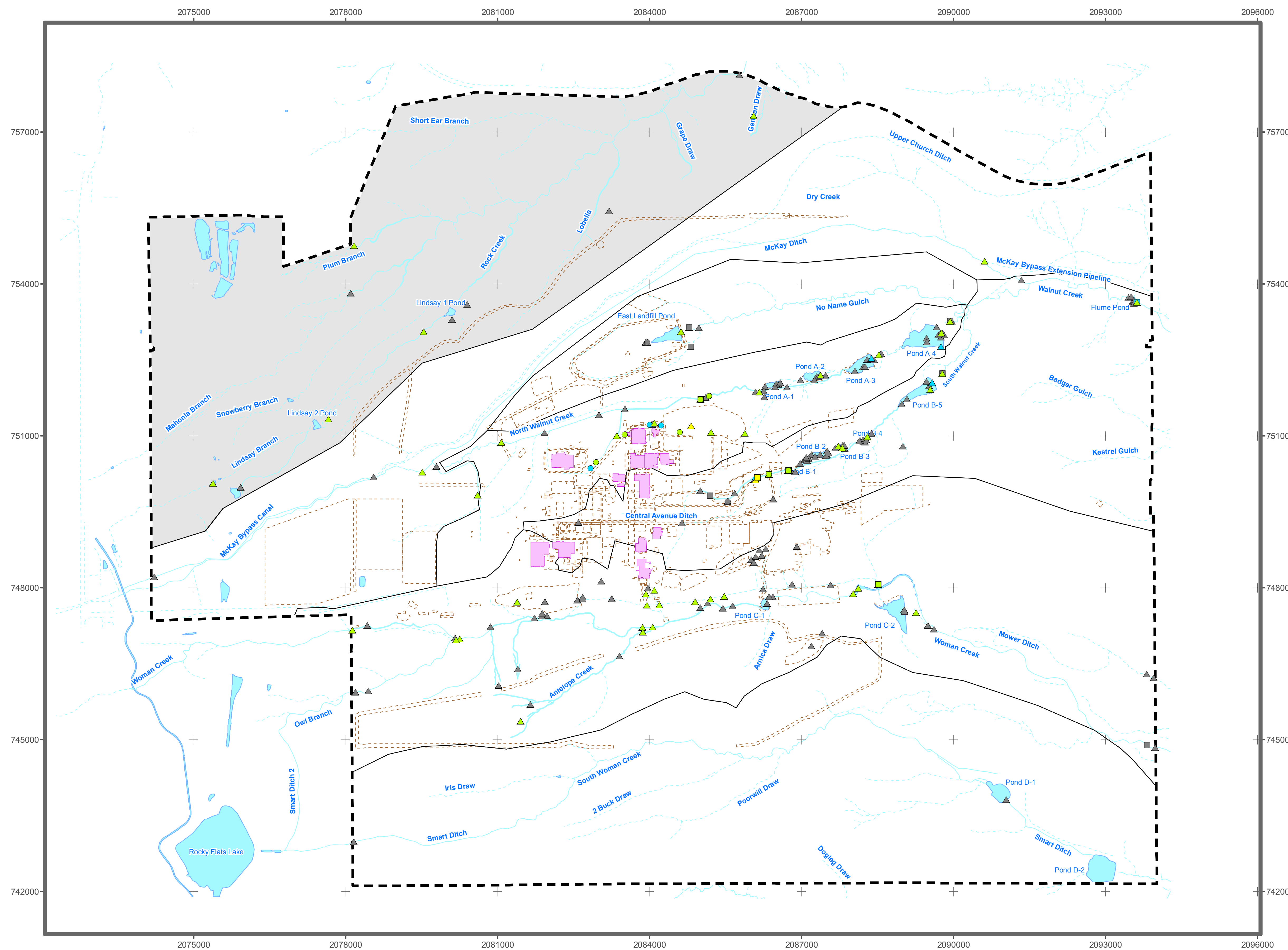
Figure A3.4.RC AEU.4

Cadmium (dissolved) Concentrations in Sitewide Surface Water



KEY

- ○ Sample collected since October 1, 2000
- □ Sample collected between October 1, 1996 and October 1, 2000
- △ Sample collected between October 1, 1991 and October 1, 1996
- Concentration > Max Background MDC
- Concentration > ESL and <= Max Background MDC
- Concentration <= ESL
- Nondetect (ND)

ESL = 0.00025 mg/L
Max Background MDC = 0.017 mg/L

Standard Map Features

- Rock Creek AEU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Technology Site

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Figure A3.4.RC AEU.5
Rock Creek Surface Water Sampling Location SW005 for Dissolved Cadmium

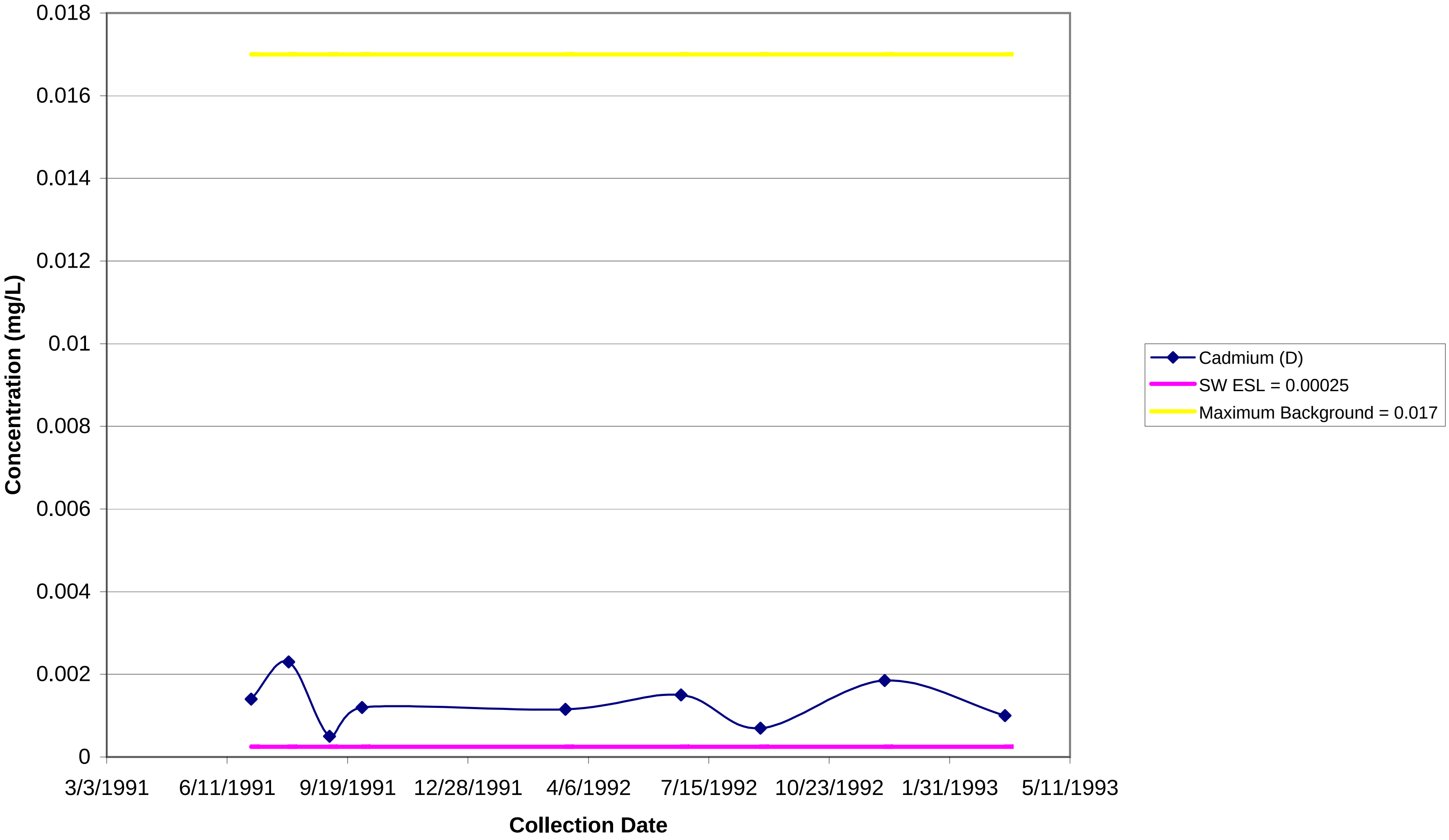


Figure A3.4.RC AEU.6
Rock Creek Surface Water Sampling Location SW006 for Dissolved Cadmium

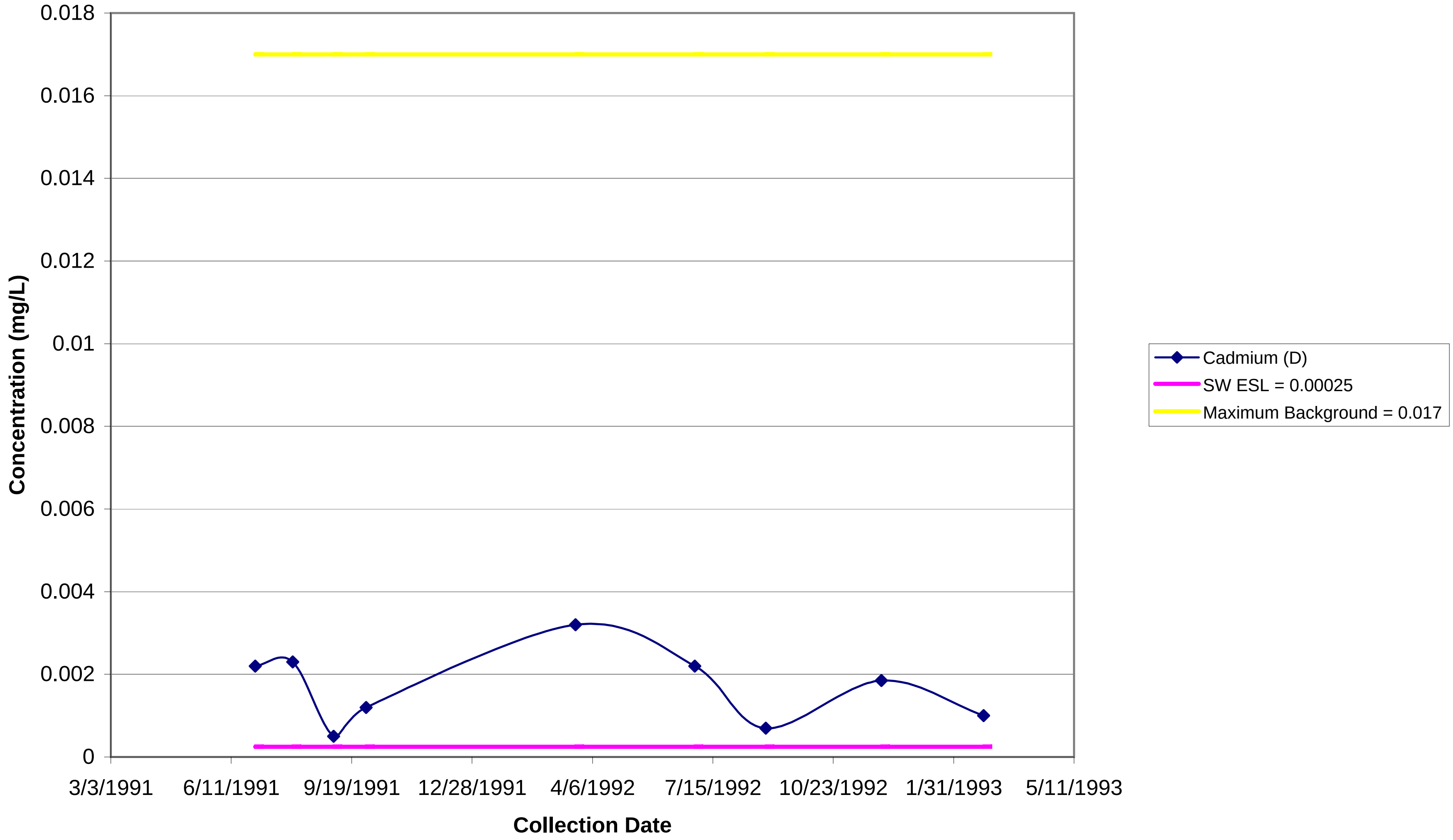


Figure A3.4.RC AEU.7
Rock Creek Surface Water Sampling Location SW108 for Dissolved Cadmium

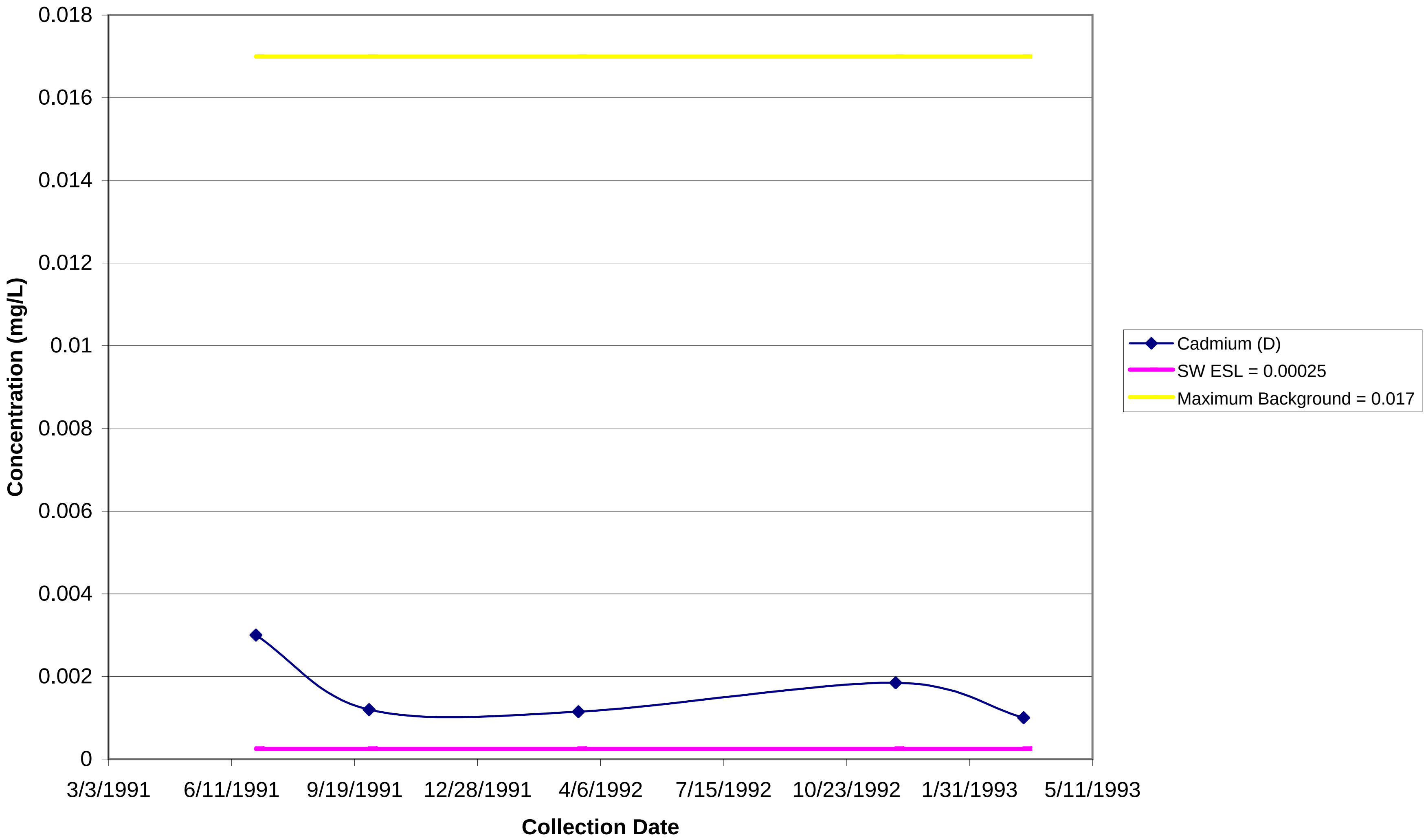


Figure A3.4.RC AEU.8
Rock Creek Surface Water Sampling Location SW135 for Dissolved Cadmium

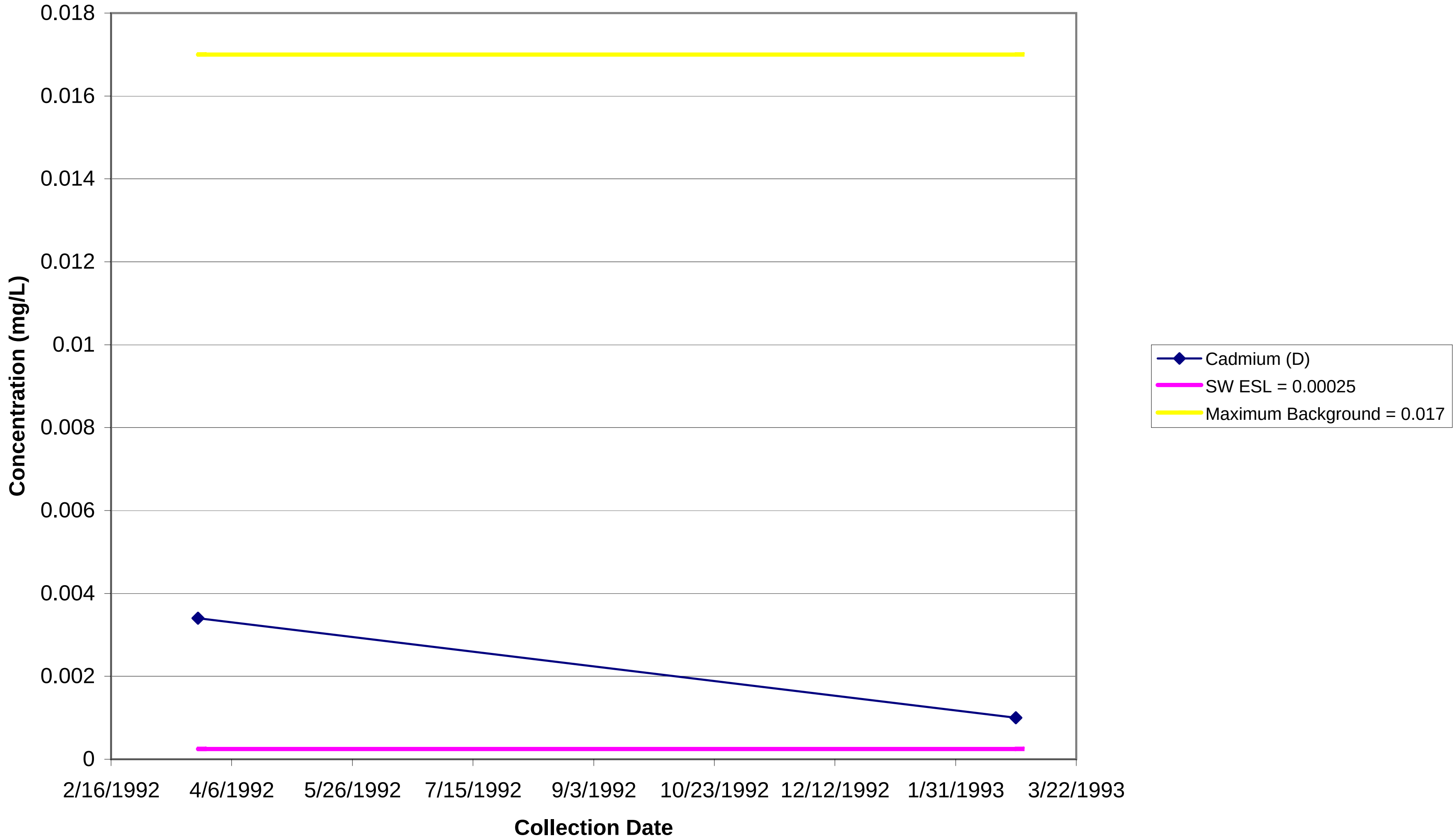


Figure A3.4.RC AEU.9
Rock Creek Surface Water Sampling Location SW137 for Dissolved Cadmium

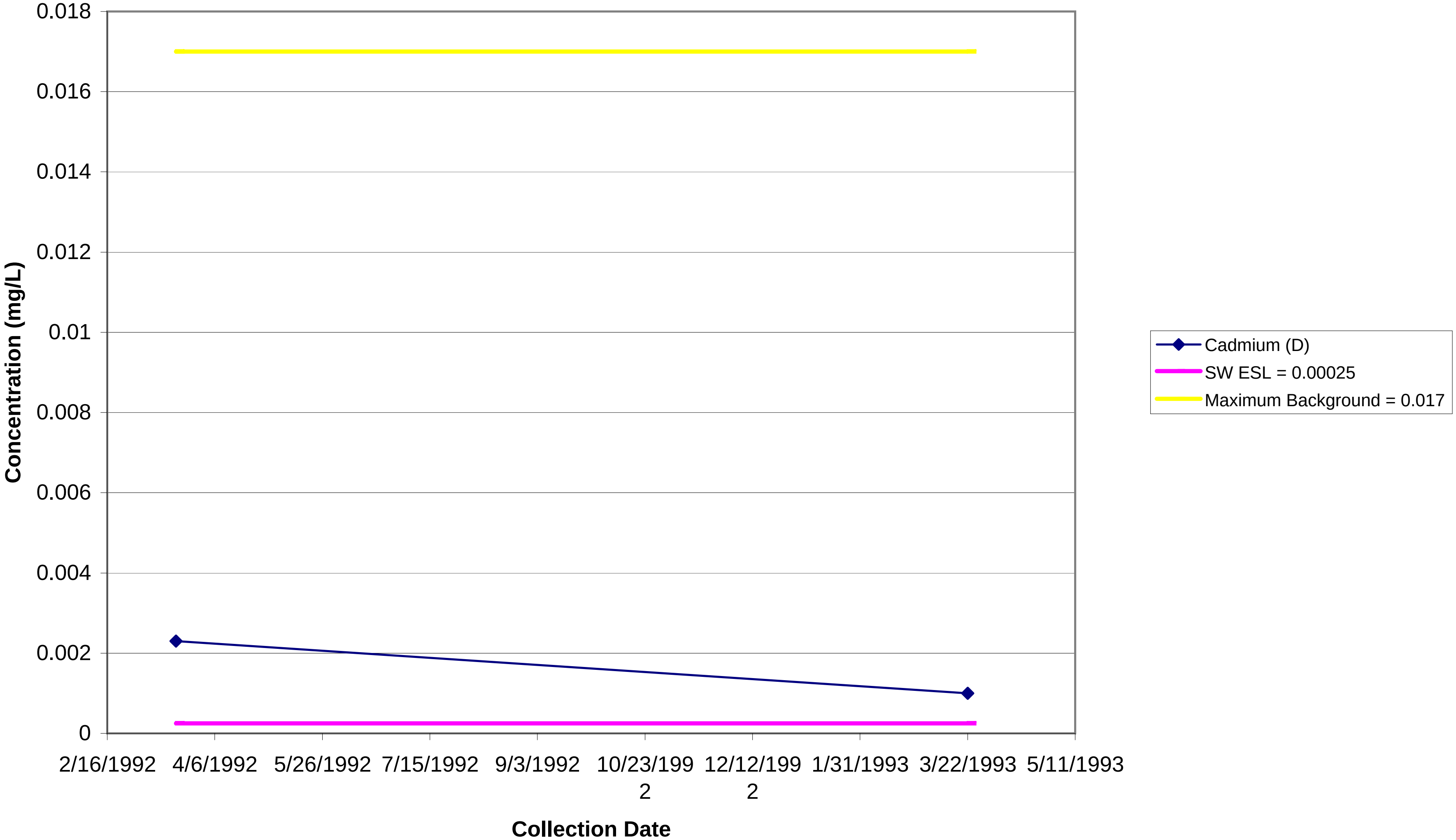
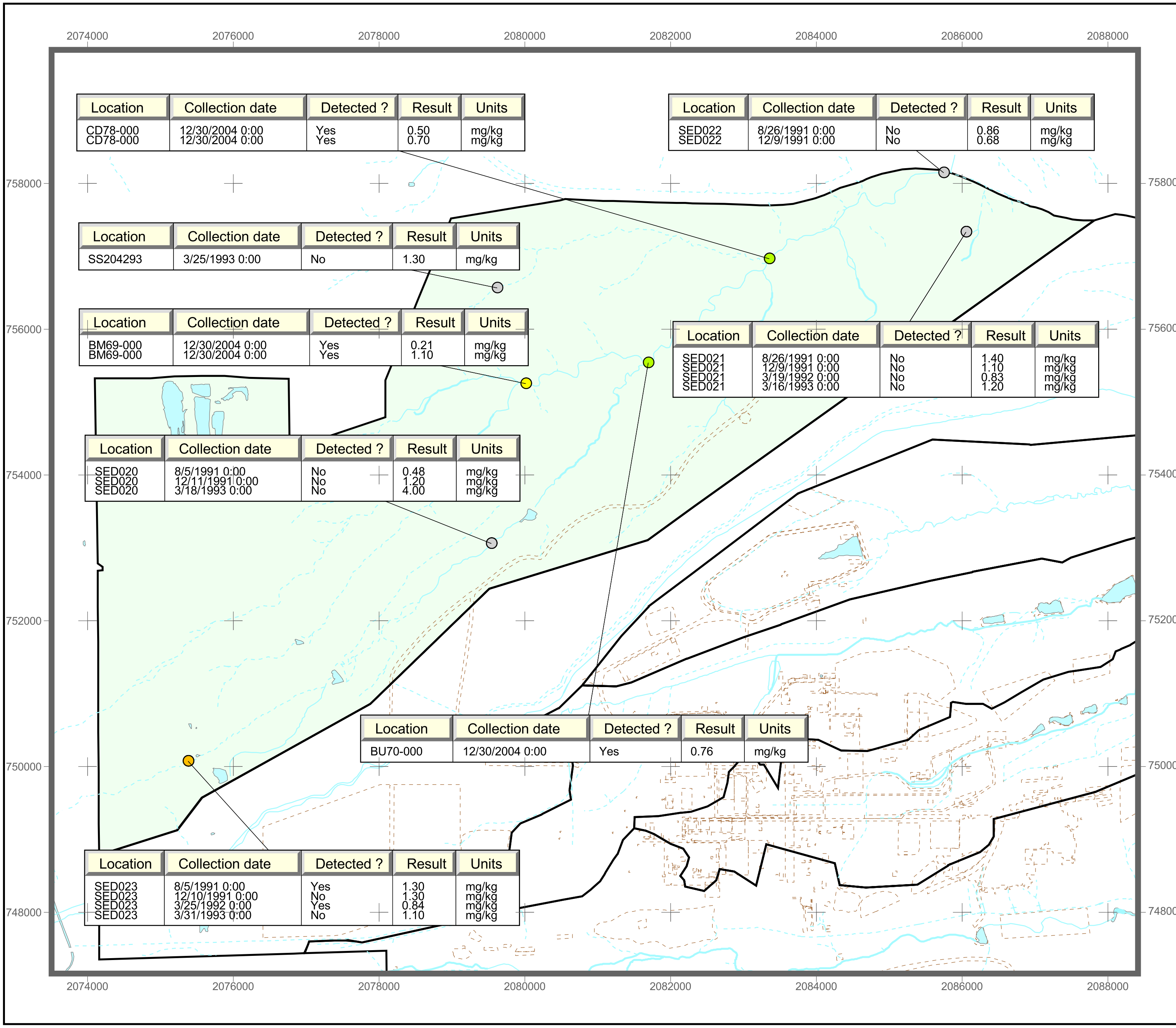


Figure A 3.4.RC AEU.10
Rock Creek AEU
Sediment Sampling Locations
for Cadmium



KEY

Sampling location

- Detect >= ESL >= Maximum background
- Detect >=ESL < Maximum Background
- Detect < ESL < Maximum Background
- Nondetect

ESL = 0.99 mg/kg

Maximum background = 1.3 mg/kg

Standard Map Features

- Rock Creek AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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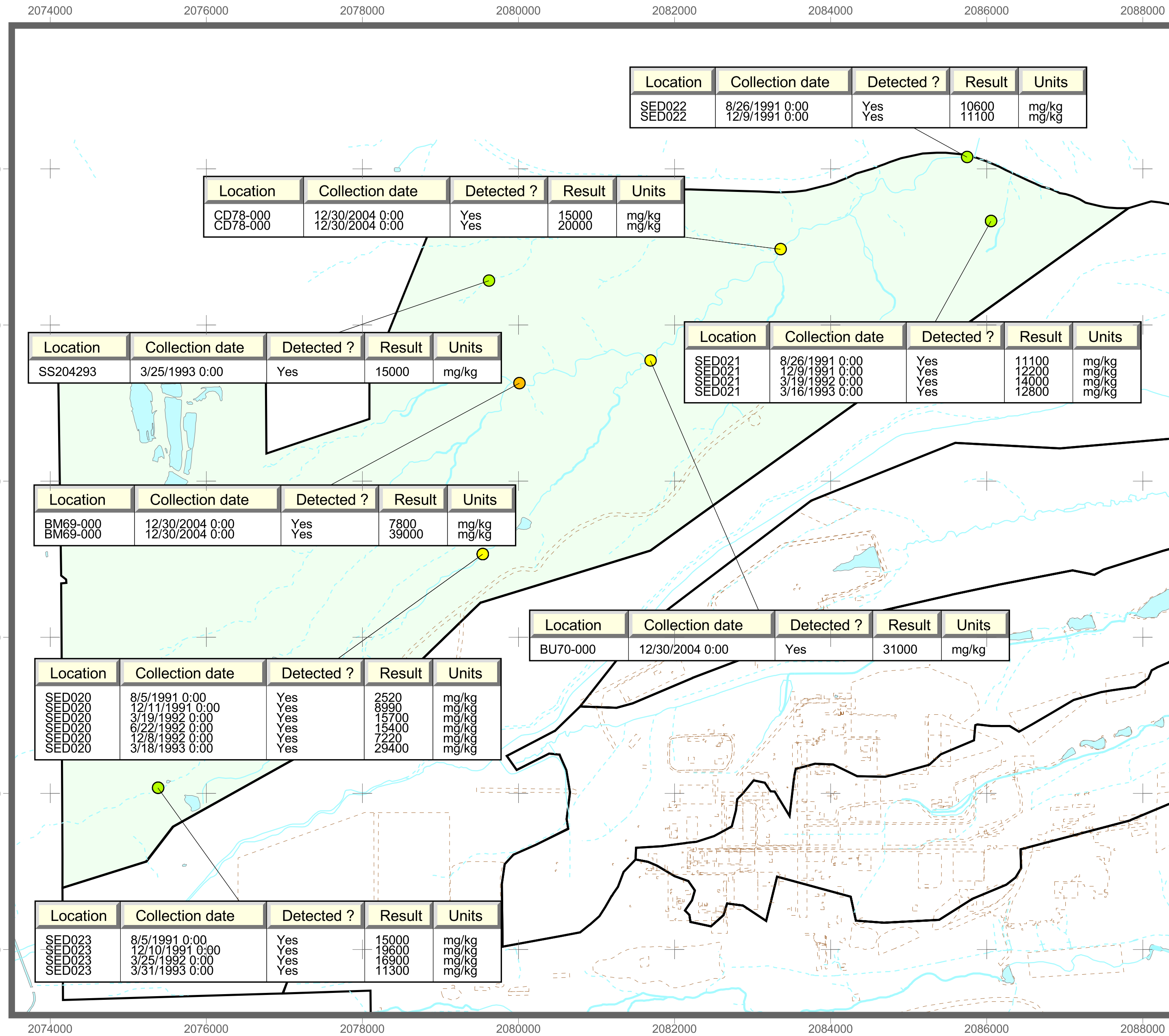
Figure A3.4.RC AEU.11
Rock Creek AEU
Sediment Sampling Locations for Iron



Location	Collection date	Detected ?	Result	Units
SED022	8/26/1991 0:00	Yes	10600	mg/kg
SED022	12/9/1991 0:00	Yes	11100	mg/kg

Location	Collection date	Detected ?	Result	Units
CD78-000	12/30/2004 0:00	Yes	15000	mg/kg
CD78-000	12/30/2004 0:00	Yes	20000	mg/kg

Location	Collection date	Detected ?	Result	Units
SS204293	3/25/1993 0:00	Yes	15000	mg/kg

Location	Collection date	Detected ?	Result	Units
SED021	8/26/1991 0:00	Yes	11100	mg/kg
SED021	12/9/1991 0:00	Yes	12200	mg/kg
SED021	3/19/1992 0:00	Yes	14000	mg/kg
SED021	3/16/1993 0:00	Yes	12800	mg/kg

Location	Collection date	Detected ?	Result	Units
BM69-000	12/30/2004 0:00	Yes	7800	mg/kg
BM69-000	12/30/2004 0:00	Yes	39000	mg/kg

Location	Collection date	Detected ?	Result	Units
BU70-000	12/30/2004 0:00	Yes	31000	mg/kg

Location	Collection date	Detected ?	Result	Units
SED020	8/5/1991 0:00	Yes	2520	mg/kg
SED020	12/11/1991 0:00	Yes	8990	mg/kg
SED020	3/19/1992 0:00	Yes	15700	mg/kg
SED020	6/22/1992 0:00	Yes	15400	mg/kg
SED020	12/8/1992 0:00	Yes	7220	mg/kg
SED020	3/18/1993 0:00	Yes	29400	mg/kg

Location	Collection date	Detected ?	Result	Units
SED023	8/5/1991 0:00	Yes	15000	mg/kg
SED023	12/10/1991 0:00	Yes	19600	mg/kg
SED023	3/25/1992 0:00	Yes	16900	mg/kg
SED023	3/31/1993 0:00	Yes	11300	mg/kg

KEY

Sampling location

- Detect >= ESL >= Maximum background
- Detect >=ESL < Maximum Background
- Detect < ESL < Maximum Background
- Nondetect

ESL = 20000 mg/kg

Maximum background = 31400 mg/kg

Standard Map Features

- Rock Creek AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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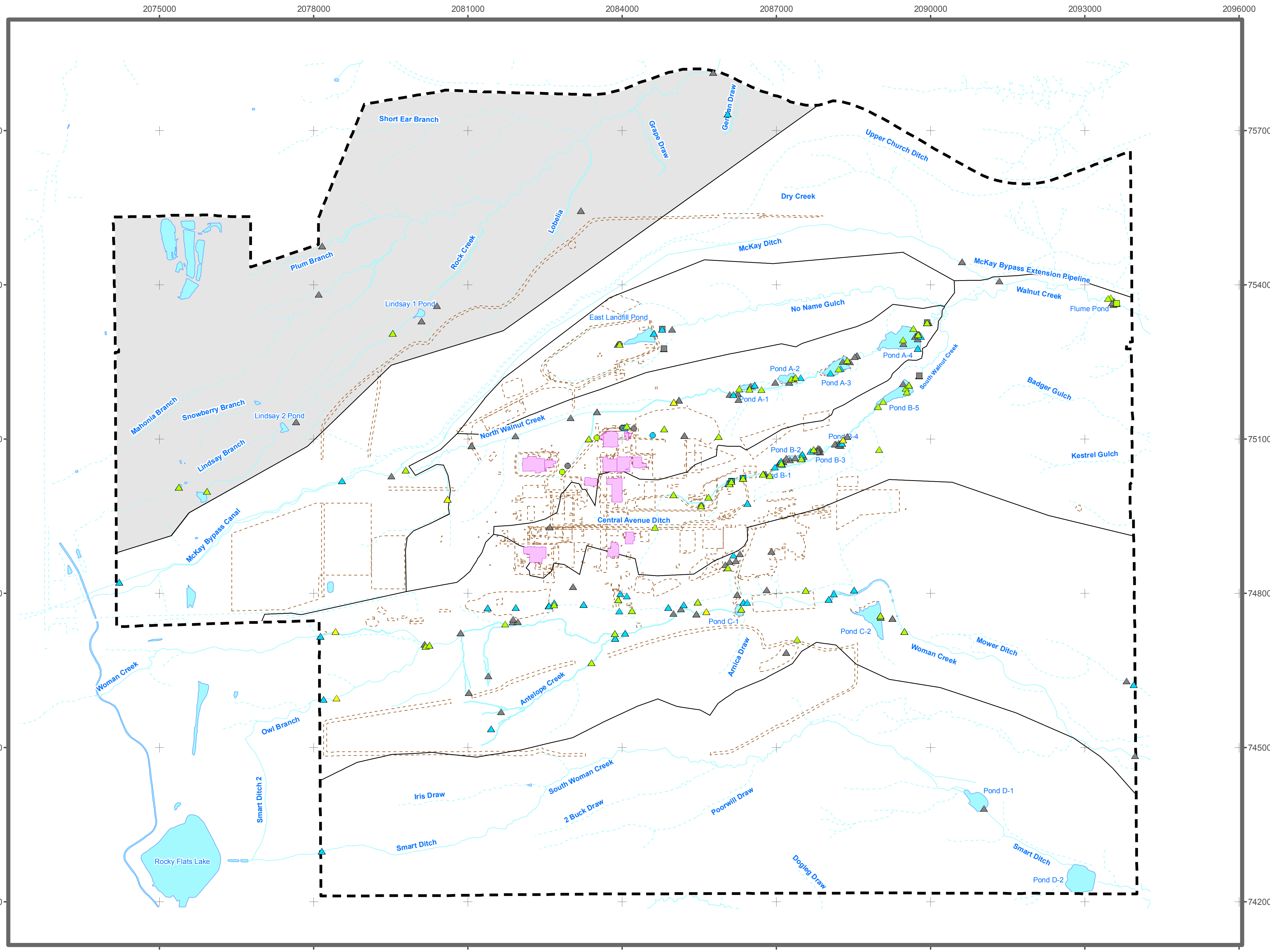

Figure A3.4.RC AEU.12

Lead (dissolved) Concentrations in Sitewide Surface Water

KEY

- ○ Sample collected since October 1, 2000
- □ Sample collected between October 1, 1996 and October 1, 2000
- △ Sample collected between October 1, 1991 and October 1, 1996

- Concentration > Max Background MDC
- Concentration > ESL and <= Max Background MDC
- Concentration <= ESL
- Nondetect (ND)

ESL = 0.0025 mg/L
Max Background MDC = 0.013 mg/L

Standard Map Features

- Rock Creek AEU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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Figure A3.4.RC AEU.13
Rock Creek Surface Water Sampling Location SW005 for Dissolved Lead

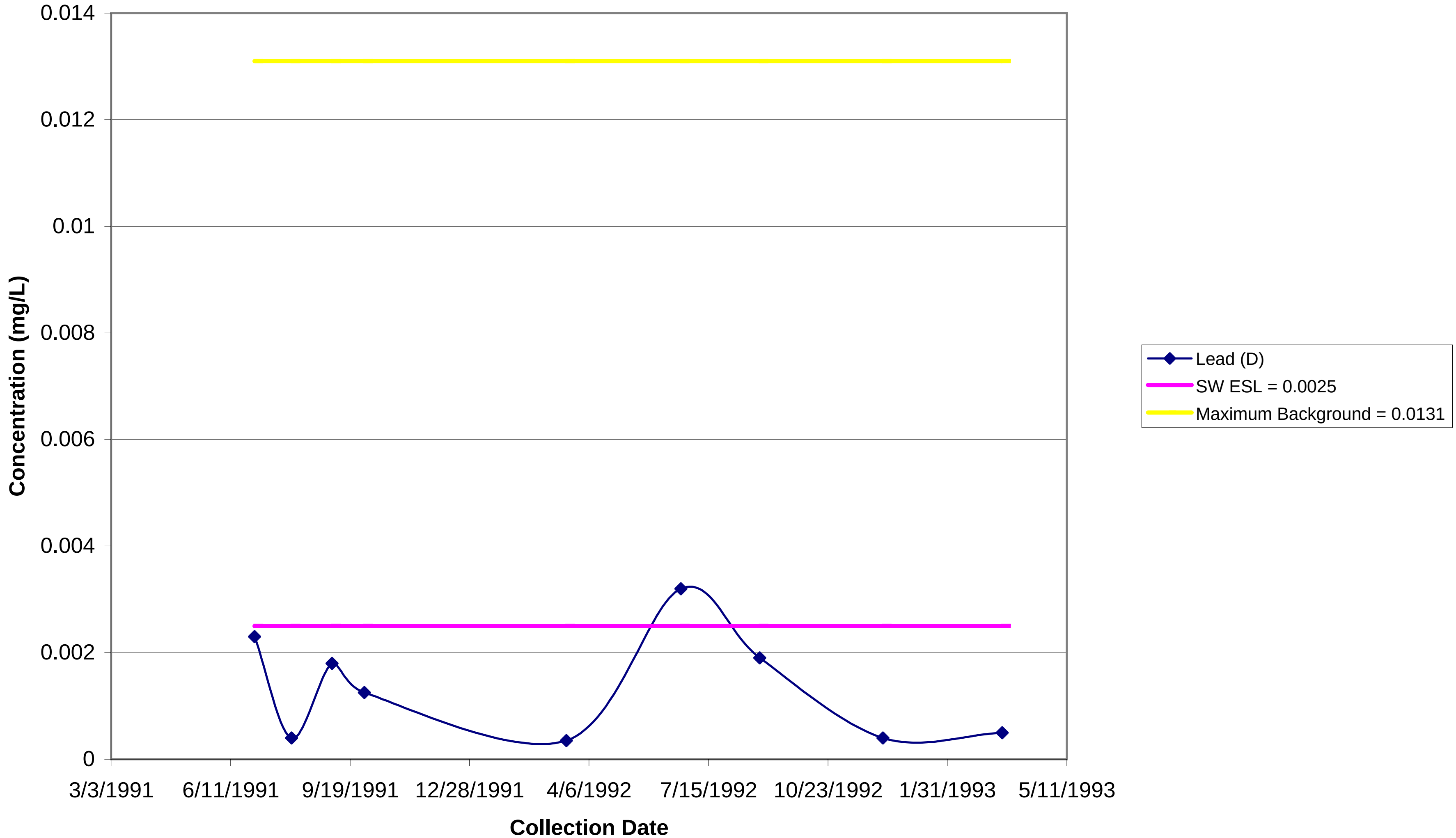


Figure A3.4.RC AEU.14
Rock Creek Surface Water Sampling Location SW006 for Dissolved Lead

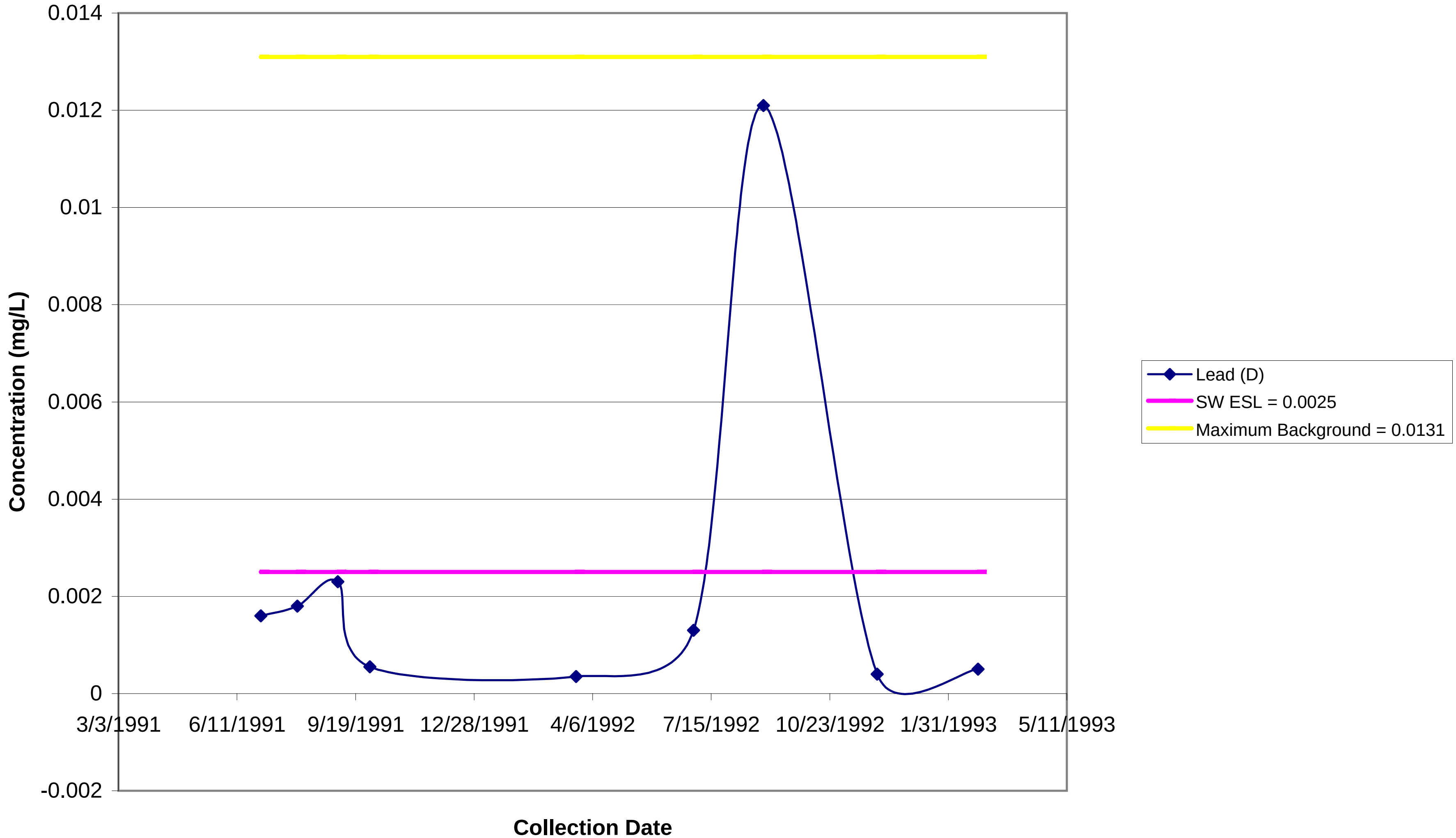


Figure A3.4.RC AEU.15
Rock Creek Surface Water Sampling Location SW134 for Dissolved Lead

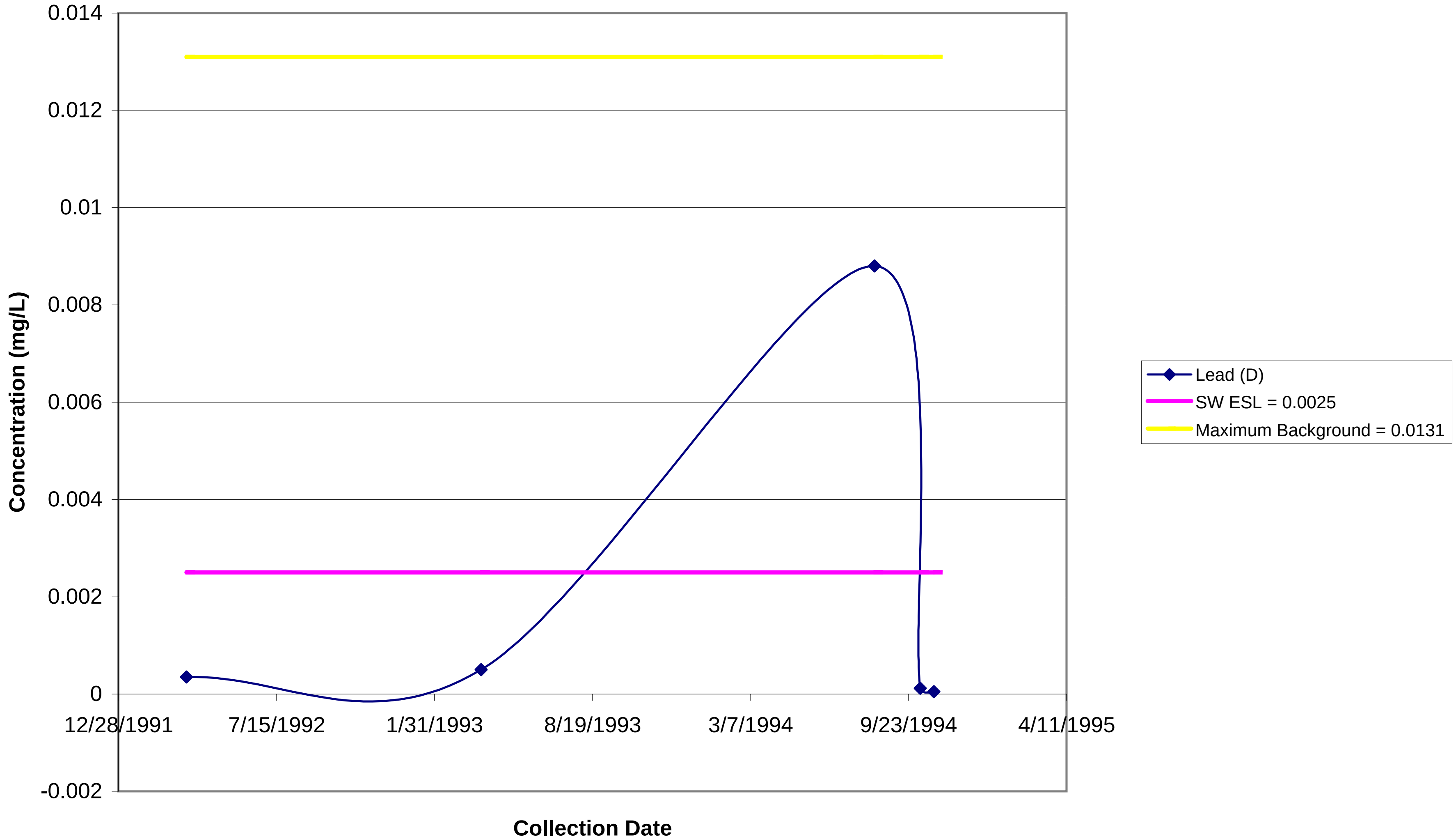
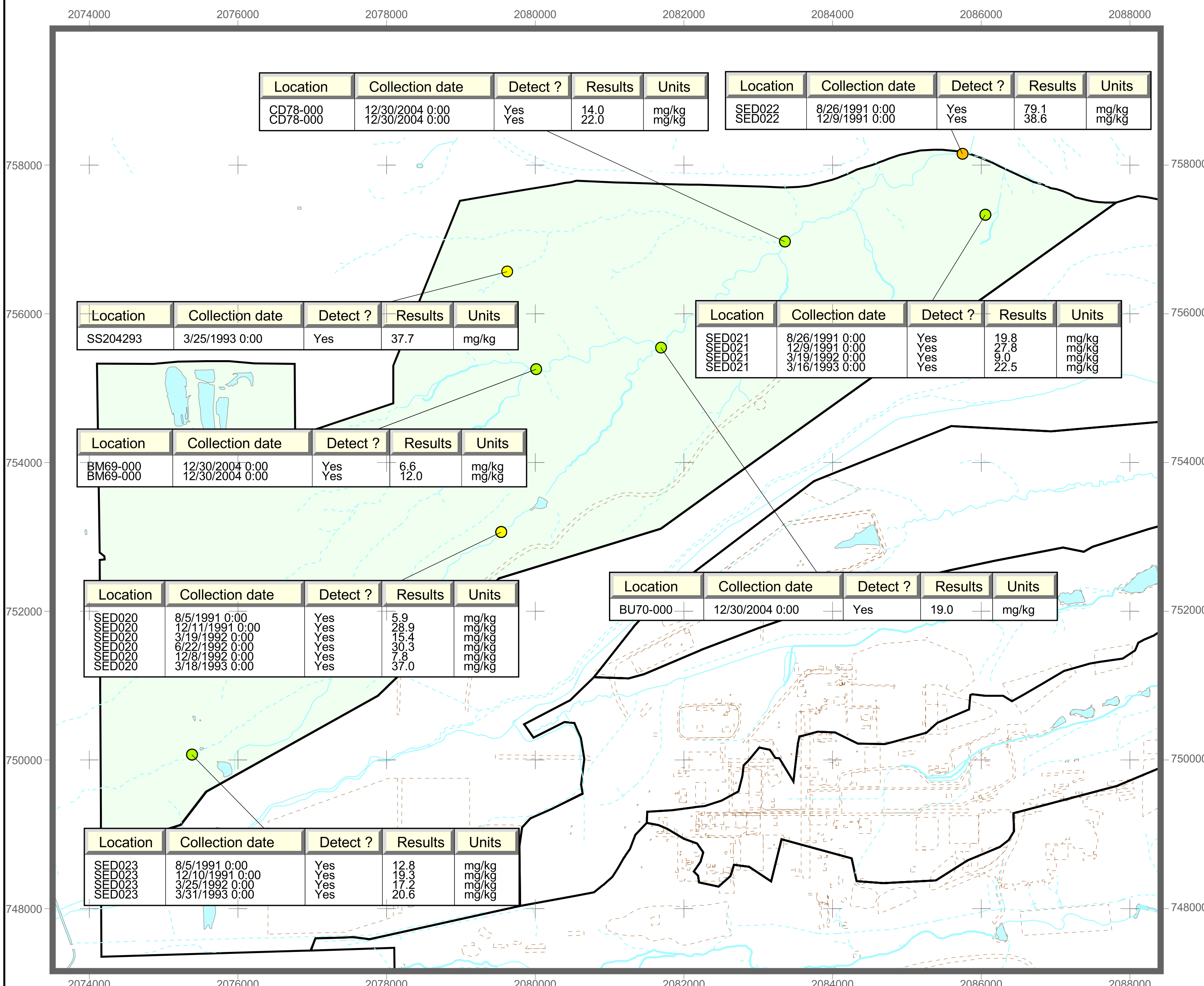


Figure A3.4.RC AEU.16
Rock Creek AEU
Sediment Sampling Locations
for Lead



Location	Collection date	Detect ?	Results	Units
CD78-000	12/30/2004 0:00	Yes	14.0	mg/kg
CD78-000	12/30/2004 0:00	Yes	22.0	mg/kg

Location	Collection date	Detect ?	Results	Units
SED022	8/26/1991 0:00	Yes	79.1	mg/kg
SED022	12/9/1991 0:00	Yes	38.6	mg/kg

Location	Collection date	Detect ?	Results	Units
SS204293	3/25/1993 0:00	Yes	37.7	mg/kg

Location	Collection date	Detect ?	Results	Units
SED021	8/26/1991 0:00	Yes	19.8	mg/kg
SED021	12/9/1991 0:00	Yes	27.8	mg/kg
SED021	3/19/1992 0:00	Yes	9.0	mg/kg
SED021	3/16/1993 0:00	Yes	22.5	mg/kg

Location	Collection date	Detect ?	Results	Units
BM69-000	12/30/2004 0:00	Yes	6.6	mg/kg
BM69-000	12/30/2004 0:00	Yes	12.0	mg/kg

Location	Collection date	Detect ?	Results	Units
BU70-000	12/30/2004 0:00	Yes	19.0	mg/kg

Location	Collection date	Detect ?	Results	Units
SED020	8/5/1991 0:00	Yes	5.9	mg/kg
SED020	12/11/1991 0:00	Yes	28.9	mg/kg
SED020	3/19/1992 0:00	Yes	15.4	mg/kg
SED020	6/22/1992 0:00	Yes	30.3	mg/kg
SED020	12/8/1992 0:00	Yes	7.8	mg/kg
SED020	3/18/1993 0:00	Yes	37.0	mg/kg

Location	Collection date	Detect ?	Results	Units
SED023	8/5/1991 0:00	Yes	12.8	mg/kg
SED023	12/10/1991 0:00	Yes	19.3	mg/kg
SED023	3/25/1992 0:00	Yes	17.2	mg/kg
SED023	3/31/1993 0:00	Yes	20.6	mg/kg

KEY

Sampling location

- Detect >= ESL >= Maximum background
- Detect >=ESL < Maximum Background
- Detect < ESL < Maximum Background
- Nondetect

ESL = 35.8 mg/kg

Maximum background = 68.8 mg/kg

Standard Map Features

- Rock Creek AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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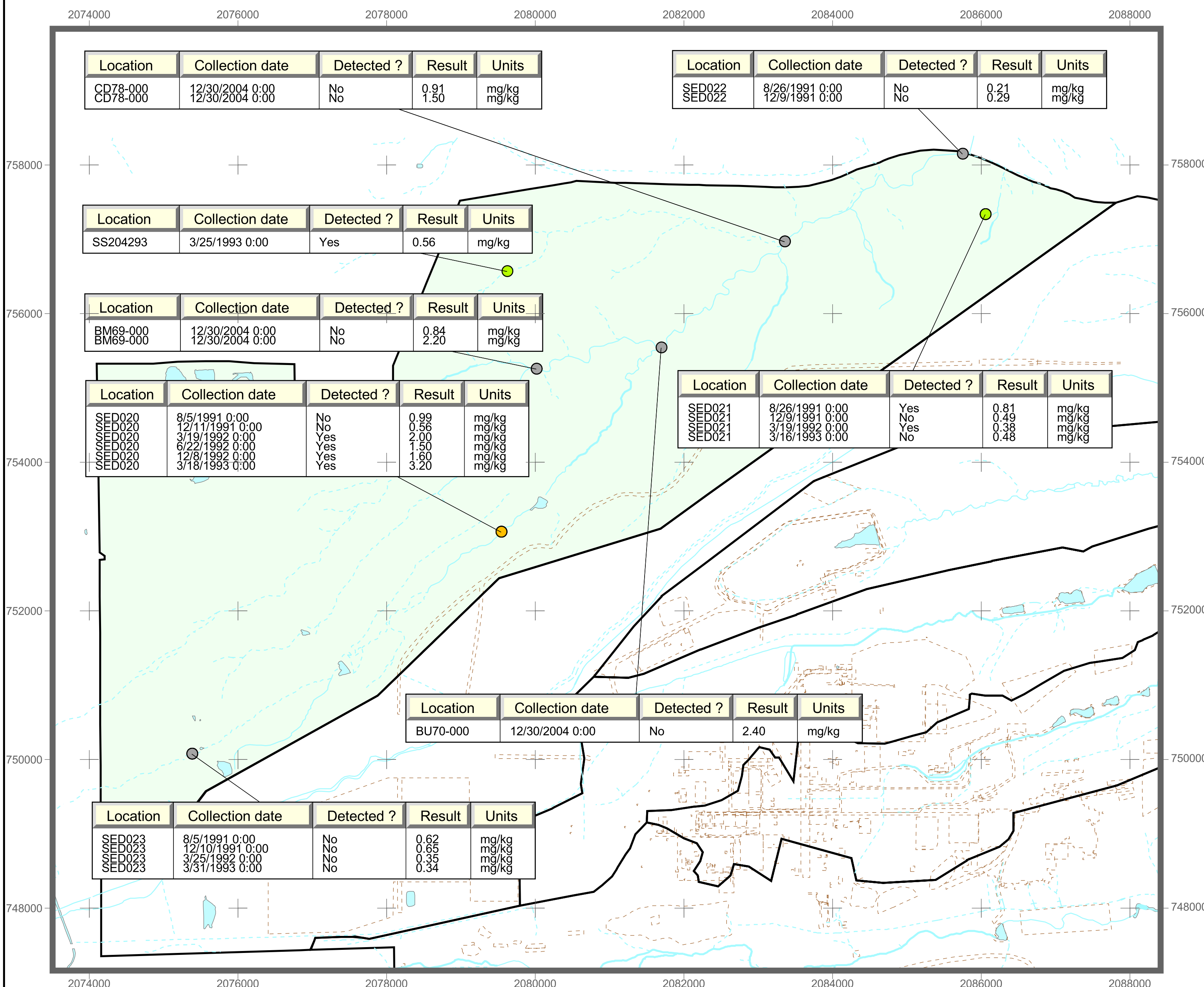
ArcView\AEU_PJ\rcaeu_pj_maps.apr



Location	Collection date	Detected ?	Result	Units
CD78-000	12/30/2004 0:00	No	0.91	mg/kg
CD78-000	12/30/2004 0:00	No	1.50	mg/kg

Location	Collection date	Detected ?	Result	Units
SED022	8/26/1991 0:00	No	0.21	mg/kg
SED022	12/9/1991 0:00	No	0.29	mg/kg

Location	Collection date	Detected ?	Result	Units
SS204293	3/25/1993 0:00	Yes	0.56	mg/kg

Location	Collection date	Detected ?	Result	Units
BM69-000	12/30/2004 0:00	No	0.84	mg/kg
BM69-000	12/30/2004 0:00	No	2.20	mg/kg

Location	Collection date	Detected ?	Result	Units
SED020	8/5/1991 0:00	No	0.99	mg/kg
SED020	12/11/1991 0:00	No	0.56	mg/kg
SED020	3/19/1992 0:00	Yes	2.00	mg/kg
SED020	6/22/1992 0:00	Yes	1.50	mg/kg
SED020	12/8/1992 0:00	Yes	1.60	mg/kg
SED020	3/18/1993 0:00	Yes	3.20	mg/kg

Location	Collection date	Detected ?	Result	Units
SED021	8/26/1991 0:00	Yes	0.81	mg/kg
SED021	12/9/1991 0:00	No	0.49	mg/kg
SED021	3/19/1992 0:00	Yes	0.38	mg/kg
SED021	3/16/1993 0:00	No	0.48	mg/kg

Location	Collection date	Detected ?	Result	Units
BU70-000	12/30/2004 0:00	No	2.40	mg/kg

Location	Collection date	Detected ?	Result	Units
SED023	8/5/1991 0:00	No	0.62	mg/kg
SED023	12/10/1991 0:00	No	0.65	mg/kg
SED023	3/25/1992 0:00	No	0.35	mg/kg
SED023	3/31/1993 0:00	No	0.34	mg/kg

Figure A3.4.RC AEU.17
Rock Creek AEU
Sediment Sampling Locations for Selenium

KEY

Sampling location

- Detect >= ESL >= Maximum background
- Detect >=ESL < Maximum Background
- Detect < ESL < Maximum Background
- Nondetect

ESL = 0.95 mg/kg

Maximum background = 3.2 mg/kg

Standard Map Features

- Rock Creek AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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0 1000 2000 Feet

Scale 1:24000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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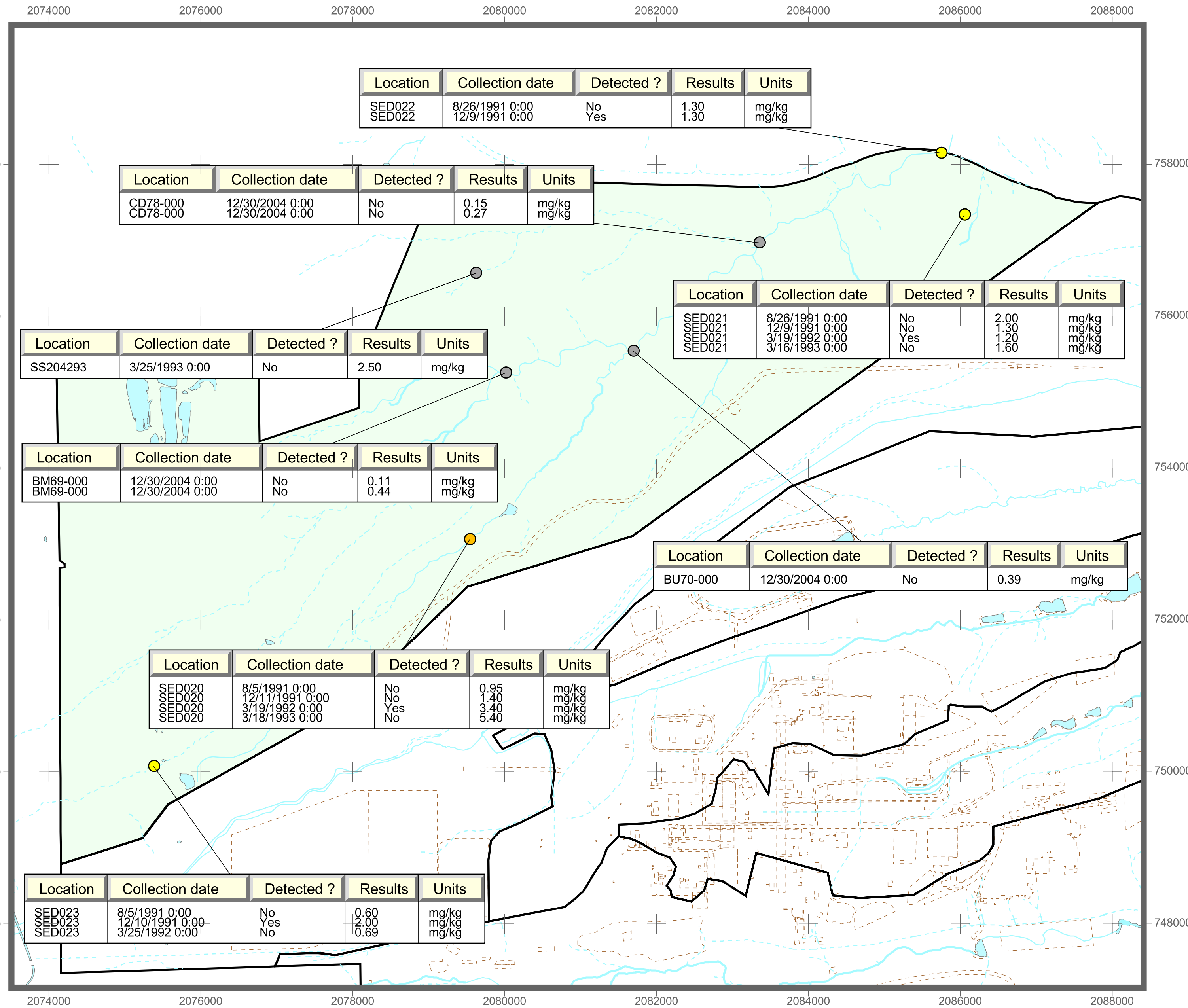

Location	Collection date	Detected ?	Results	Units
SED022	8/26/1991 0:00	No	1.30	mg/kg
SED022	12/9/1991 0:00	Yes	1.30	mg/kg

Location	Collection date	Detected ?	Results	Units
CD78-000	12/30/2004 0:00	No	0.15	mg/kg
CD78-000	12/30/2004 0:00	No	0.27	mg/kg

Location	Collection date	Detected ?	Results	Units
SED021	8/26/1991 0:00	No	2.00	mg/kg
SED021	12/9/1991 0:00	No	1.30	mg/kg
SED021	3/19/1992 0:00	Yes	1.20	mg/kg
SED021	3/16/1993 0:00	No	1.60	mg/kg

Location	Collection date	Detected ?	Results	Units
SS204293	3/25/1993 0:00	No	2.50	mg/kg

Location	Collection date	Detected ?	Results	Units
BM69-000	12/30/2004 0:00	No	0.11	mg/kg
BM69-000	12/30/2004 0:00	No	0.44	mg/kg

Location	Collection date	Detected ?	Results	Units
BU70-000	12/30/2004 0:00	No	0.39	mg/kg

Location	Collection date	Detected ?	Results	Units
SED020	8/5/1991 0:00	No	0.95	mg/kg
SED020	12/11/1991 0:00	No	1.40	mg/kg
SED020	3/19/1992 0:00	Yes	3.40	mg/kg
SED020	3/18/1993 0:00	No	5.40	mg/kg

Location	Collection date	Detected ?	Results	Units
SED023	8/5/1991 0:00	No	0.60	mg/kg
SED023	12/10/1991 0:00	Yes	2.00	mg/kg
SED023	3/25/1992 0:00	No	0.69	mg/kg

Figure A3.4.RC AEU.18
Rock Creek AEU
Sediment Sampling Locations for Silver

KEY

Sampling location

- Detect >= ESL >= Maximum background
- Detect >=ESL < Maximum Background
- Detect < ESL < Maximum Background
- Nondetect

ESL = 1 mg/kg

Maximum background = 3.4 mg/kg

Standard Map Features

- Rock Creek AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N S W E

0 1000 2000 Feet

Scale 1:24000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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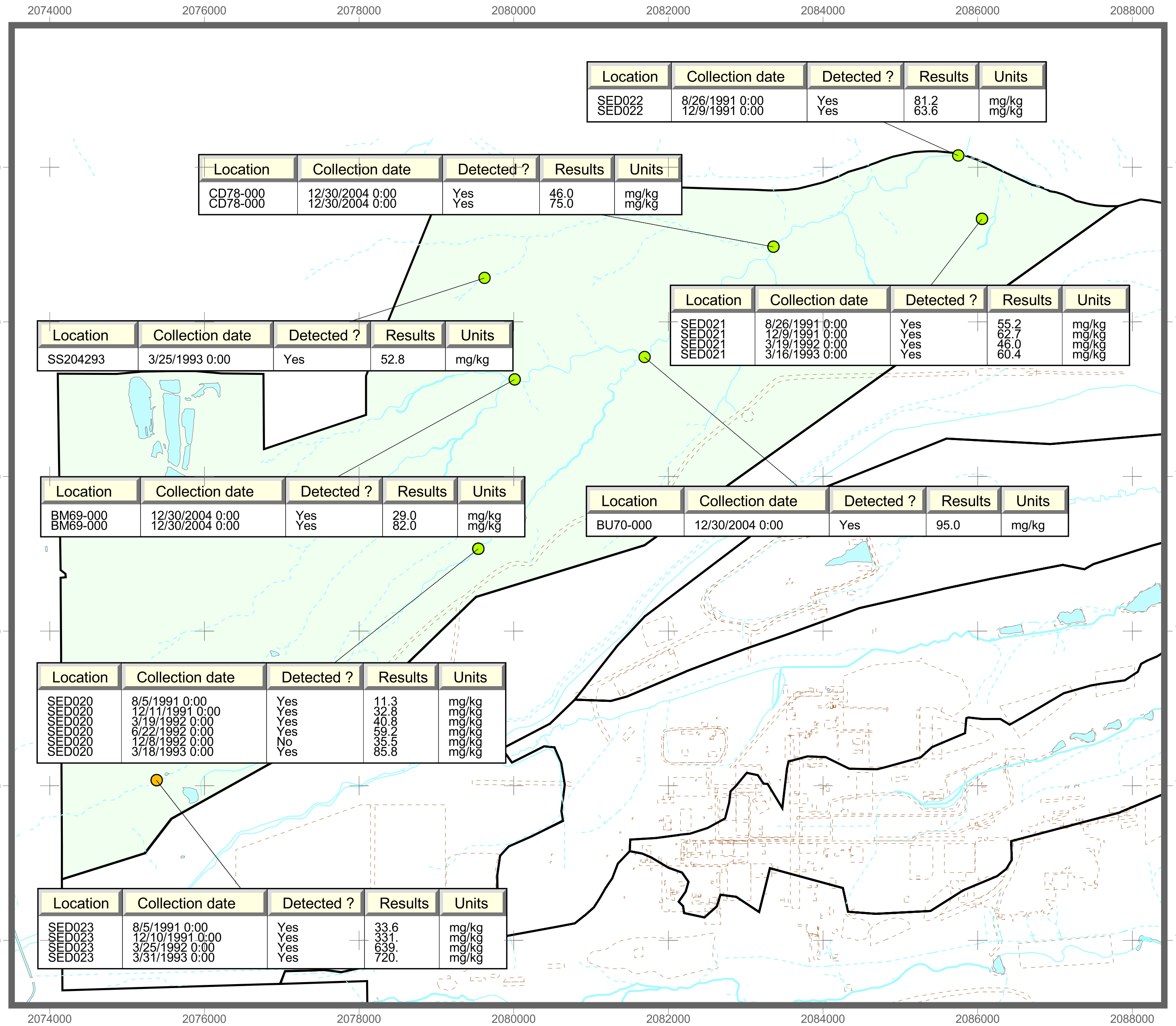

Location	Collection date	Detected ?	Results	Units
SED022	8/26/1991 0:00	Yes	81.2	mg/kg
SED022	12/9/1991 0:00	Yes	63.6	mg/kg

Location	Collection date	Detected ?	Results	Units
CD78-000	12/30/2004 0:00	Yes	46.0	mg/kg
CD78-000	12/30/2004 0:00	Yes	75.0	mg/kg

Location	Collection date	Detected ?	Results	Units
SED021	8/26/1991 0:00	Yes	55.2	mg/kg
SED021	12/9/1991 0:00	Yes	62.7	mg/kg
SED021	3/19/1992 0:00	Yes	46.0	mg/kg
SED021	3/16/1993 0:00	Yes	60.4	mg/kg

Location	Collection date	Detected ?	Results	Units
SS204293	3/25/1993 0:00	Yes	52.8	mg/kg

Location	Collection date	Detected ?	Results	Units
BM69-000	12/30/2004 0:00	Yes	29.0	mg/kg
BM69-000	12/30/2004 0:00	Yes	82.0	mg/kg

Location	Collection date	Detected ?	Results	Units
BU70-000	12/30/2004 0:00	Yes	95.0	mg/kg

Location	Collection date	Detected ?	Results	Units
SED020	8/5/1991 0:00	Yes	11.3	mg/kg
SED020	12/11/1991 0:00	Yes	32.8	mg/kg
SED020	3/19/1992 0:00	Yes	40.8	mg/kg
SED020	6/22/1992 0:00	Yes	59.2	mg/kg
SED020	12/8/1992 0:00	No	35.5	mg/kg
SED020	3/18/1993 0:00	Yes	85.8	mg/kg

Location	Collection date	Detected ?	Results	Units
SED023	8/5/1991 0:00	Yes	33.6	mg/kg
SED023	12/10/1991 0:00	Yes	331.	mg/kg
SED023	3/25/1992 0:00	Yes	639.	mg/kg
SED023	3/31/1993 0:00	Yes	720.	mg/kg

Figure A3.4.RC AEU.19
Rock Creek AEU
Sediment Sampling Locations
for Zinc

KEY

Sampling location

- Detect >= ESL >= Maximum background
- Detect >=ESL < Maximum Background
- Detect < ESL < Maximum Background
- Nondetect

ESL = 121mg/kg

Maximum background = 720 mg/kg

Standard Map Features

- Rock Creek AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1000 2000 Feet

Scale 1:24000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Technology Site

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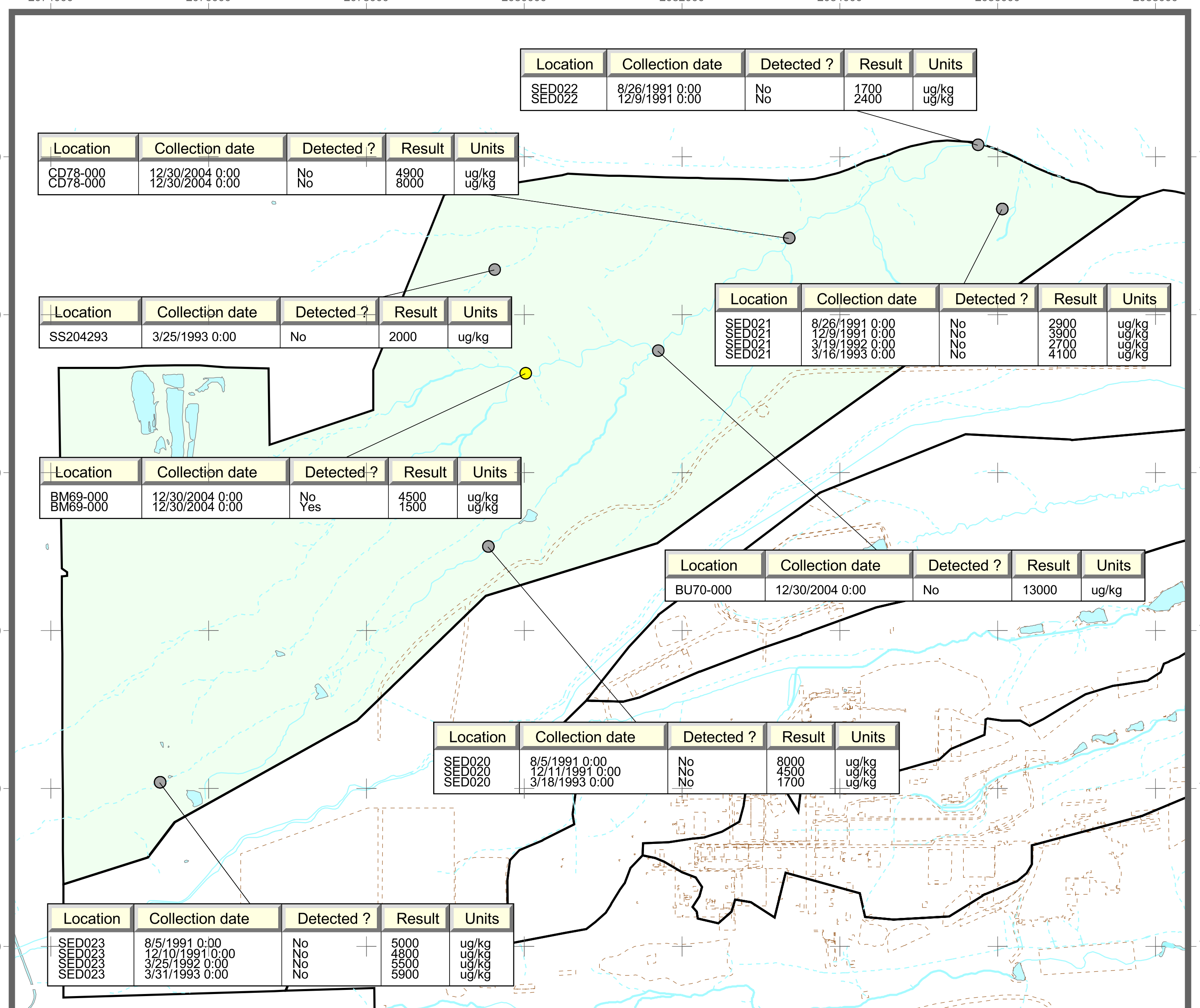
Figure A3.4.RC AEU.20
Rock Creek AEU
Sediment Sampling Locations
for Pentachlorophenol



Location	Collection date	Detected ?	Result	Units
SED022	8/26/1991 0:00	No	1700	ug/kg
SED022	12/9/1991 0:00	No	2400	ug/kg

Location	Collection date	Detected ?	Result	Units
CD78-000	12/30/2004 0:00	No	4900	ug/kg
CD78-000	12/30/2004 0:00	No	8000	ug/kg

Location	Collection date	Detected ?	Result	Units
SS204293	3/25/1993 0:00	No	2000	ug/kg

Location	Collection date	Detected ?	Result	Units
SED021	8/26/1991 0:00	No	2900	ug/kg
SED021	12/9/1991 0:00	No	3900	ug/kg
SED021	3/19/1992 0:00	No	2700	ug/kg
SED021	3/16/1993 0:00	No	4100	ug/kg

Location	Collection date	Detected ?	Result	Units
BM69-000	12/30/2004 0:00	No	4500	ug/kg
BM69-000	12/30/2004 0:00	Yes	1500	ug/kg

Location	Collection date	Detected ?	Result	Units
BU70-000	12/30/2004 0:00	No	13000	ug/kg

Location	Collection date	Detected ?	Result	Units
SED020	8/5/1991 0:00	No	8000	ug/kg
SED020	12/11/1991 0:00	No	4500	ug/kg
SED020	3/18/1993 0:00	No	1700	ug/kg

Location	Collection date	Detected ?	Result	Units
SED023	8/5/1991 0:00	No	5000	ug/kg
SED023	12/10/1991 0:00	No	4800	ug/kg
SED023	3/25/1992 0:00	No	5500	ug/kg
SED023	3/31/1993 0:00	No	5900	ug/kg

2074000 2076000 2078000 2080000 2082000 2084000 2086000 2088000

KEY

Sampling location

- Detect >=ESL
- Detect < ESL
- Nondetect

ESL = 255 ug/kg

Standard Map Features

- Rock Creek AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1000 2000 Feet

Scale 1:24000

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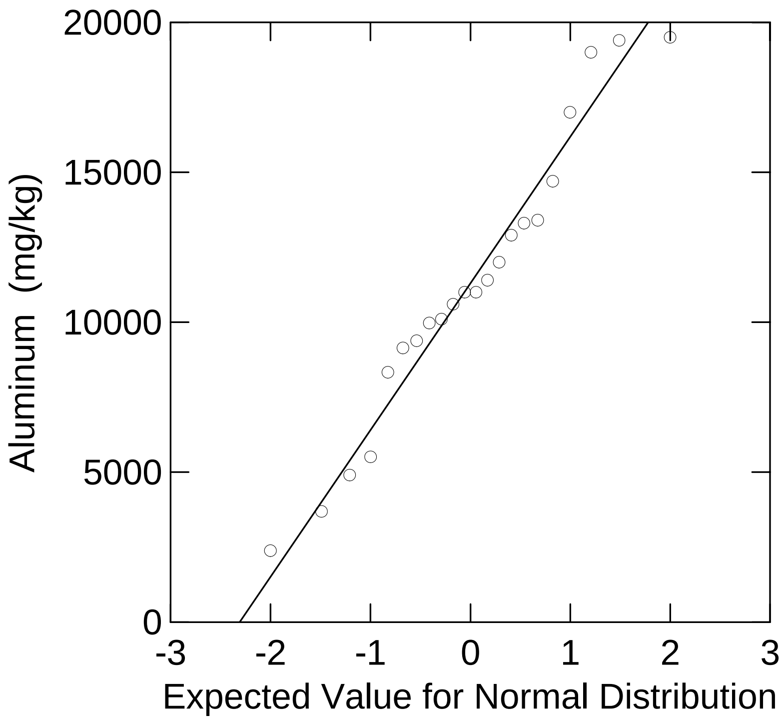


Figure A3.4.RC AEU.21 Probability Plot of Aluminum Concentrations in Sediments from RC AEU.

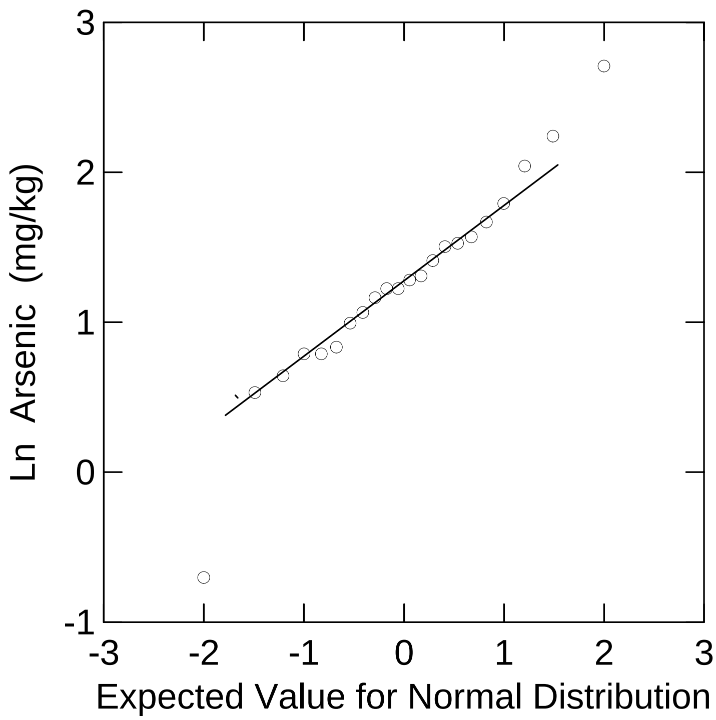


Figure A3.4.RC AEU.22 **Probability Plot of Arsenic Concentrations (Natural Logarithm) in Sediments from RC AEU.**

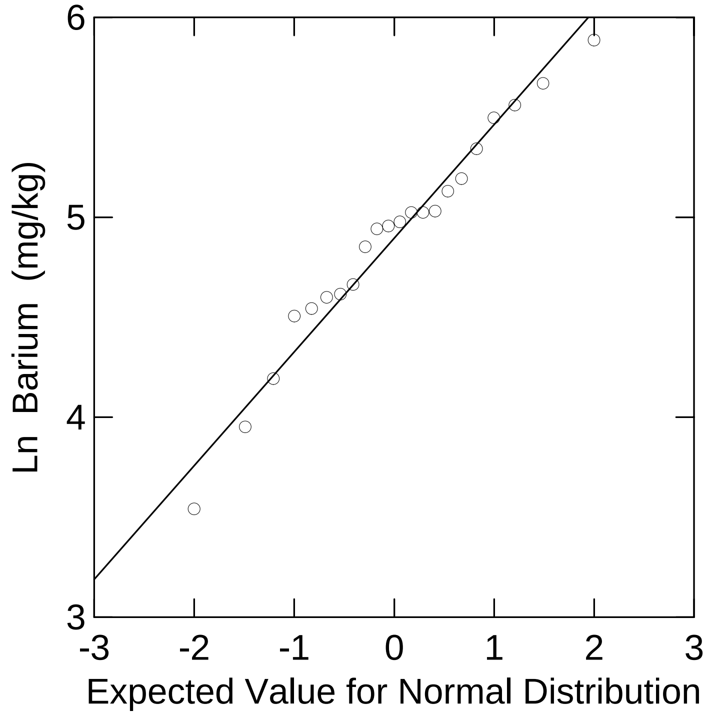


Figure A3.4.RC AEU.23 Probability Plot of Barium Concentrations (Natural Logarithm) in Sediments from RC AEU.

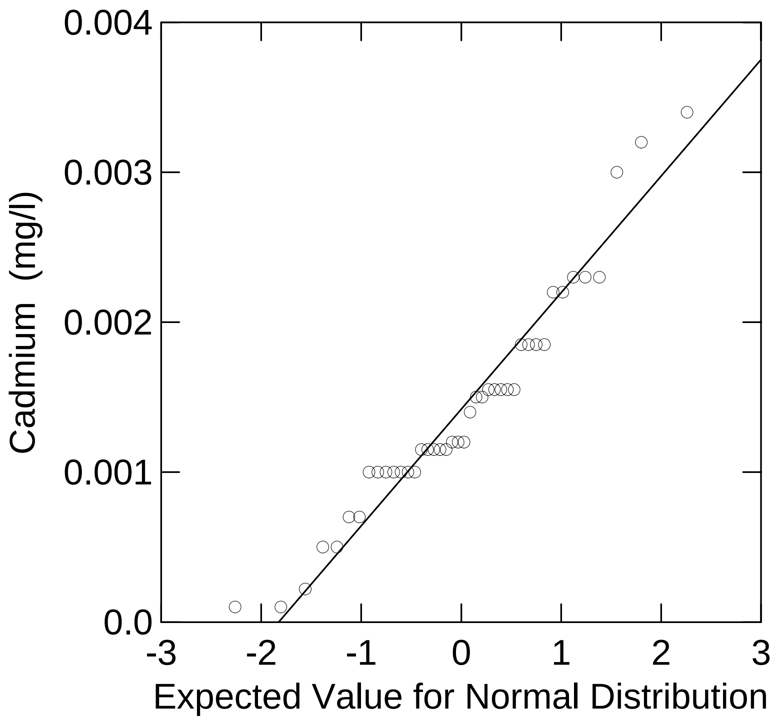


Figure A3.4.RC AEU.24 **Probability Plot of Cadmium Concentrations in Surface Water from RC AEU.**

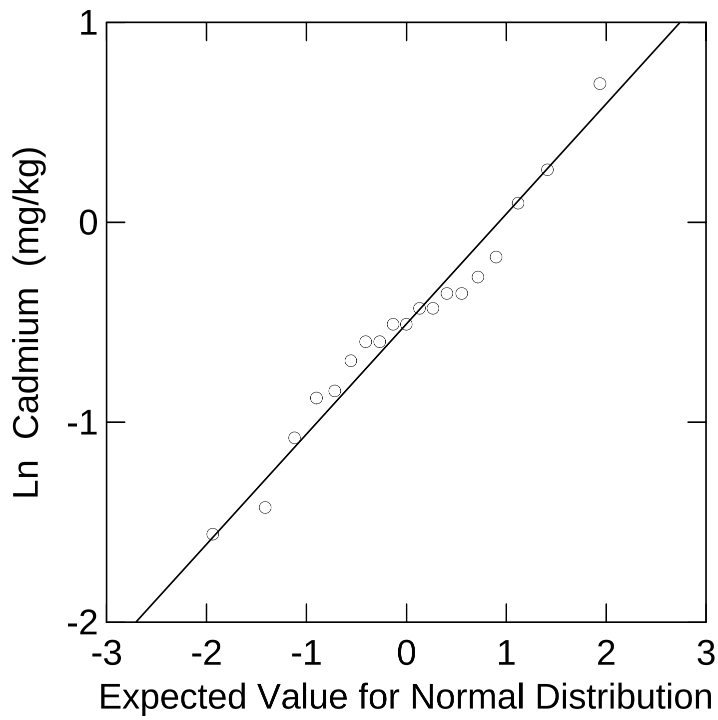


Figure A3.4.RC AEU.25 **Probability Plot of Cadmium Concentrations (Natural Logarithm) in Sediments from RC AEU.**

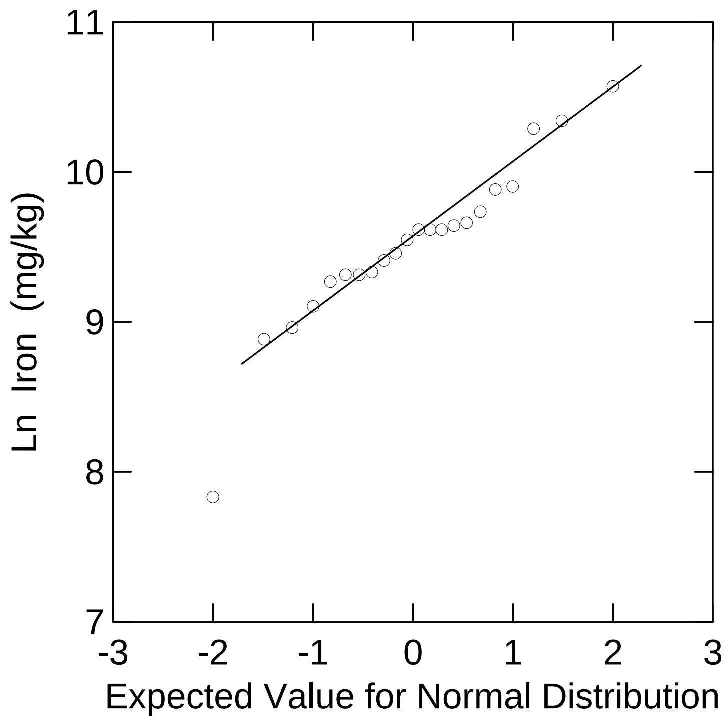


Figure A3.4.RC AEU.26 **Probability Plot of Iron Concentrations (Natural Logarithm) in Sediments from RC AEU.**

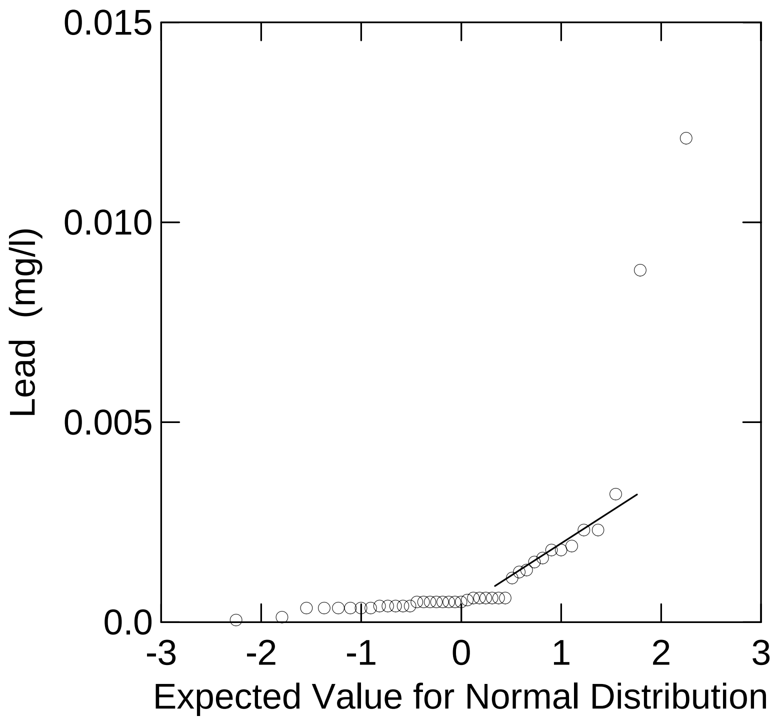


Figure A3.4.RC AEU.27 Probability Plot of Lead Concentrations in Surface Water from RC AEU.

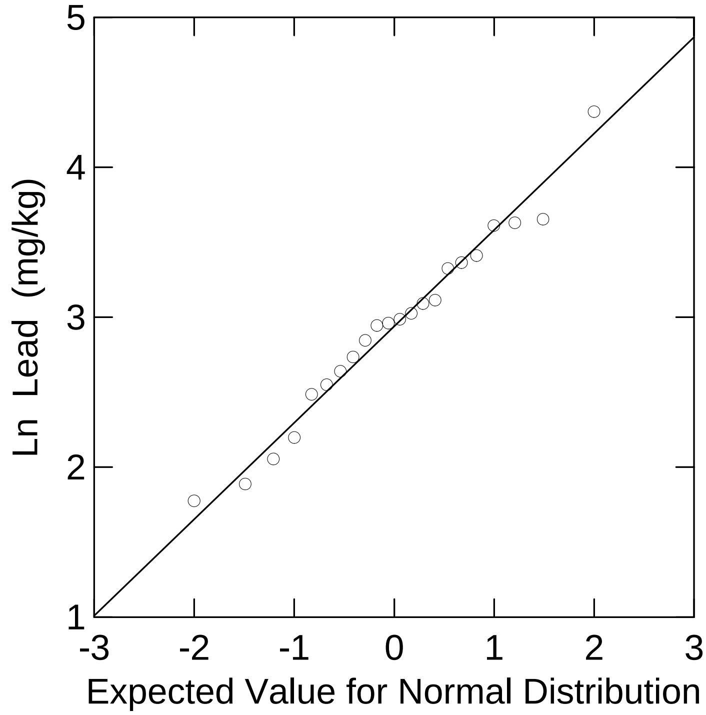


Figure A3.4.RC AEU.28 **Probability Plot of Lead Concentrations (Natural Logarithm) in Sediments from RC AEU.**

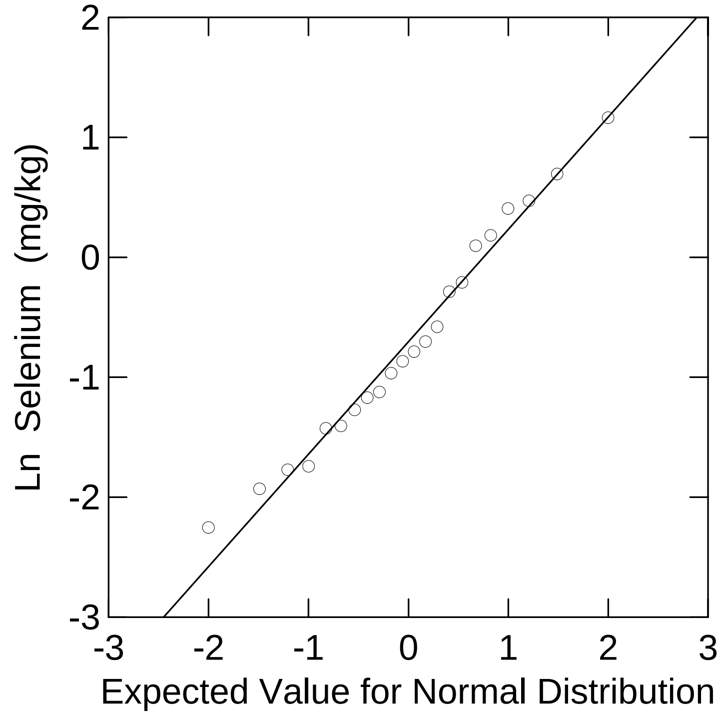


Figure A3.4.RC AEU.29 Probability Plot of Selenium Concentrations (Natural Logarithm) in Sediments from RC AEU.

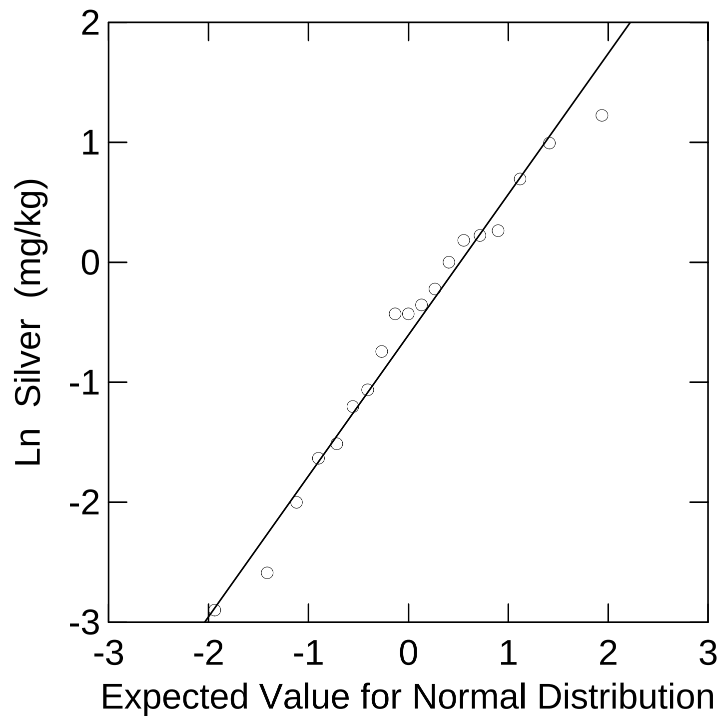


Figure A3.4.RC AEU.30 Probability Plot of Silver Concentrations (Natural Logarithm) in Sediments from RC AEU.

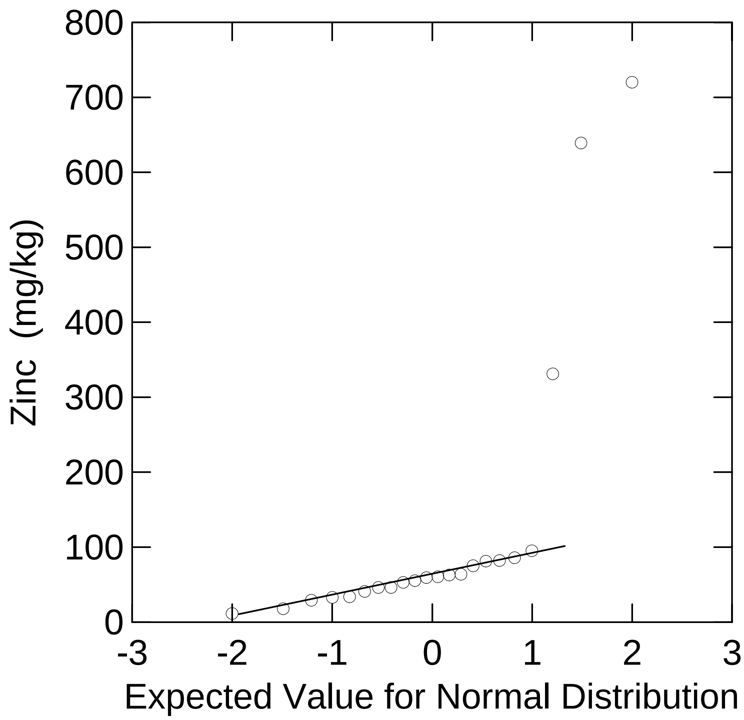
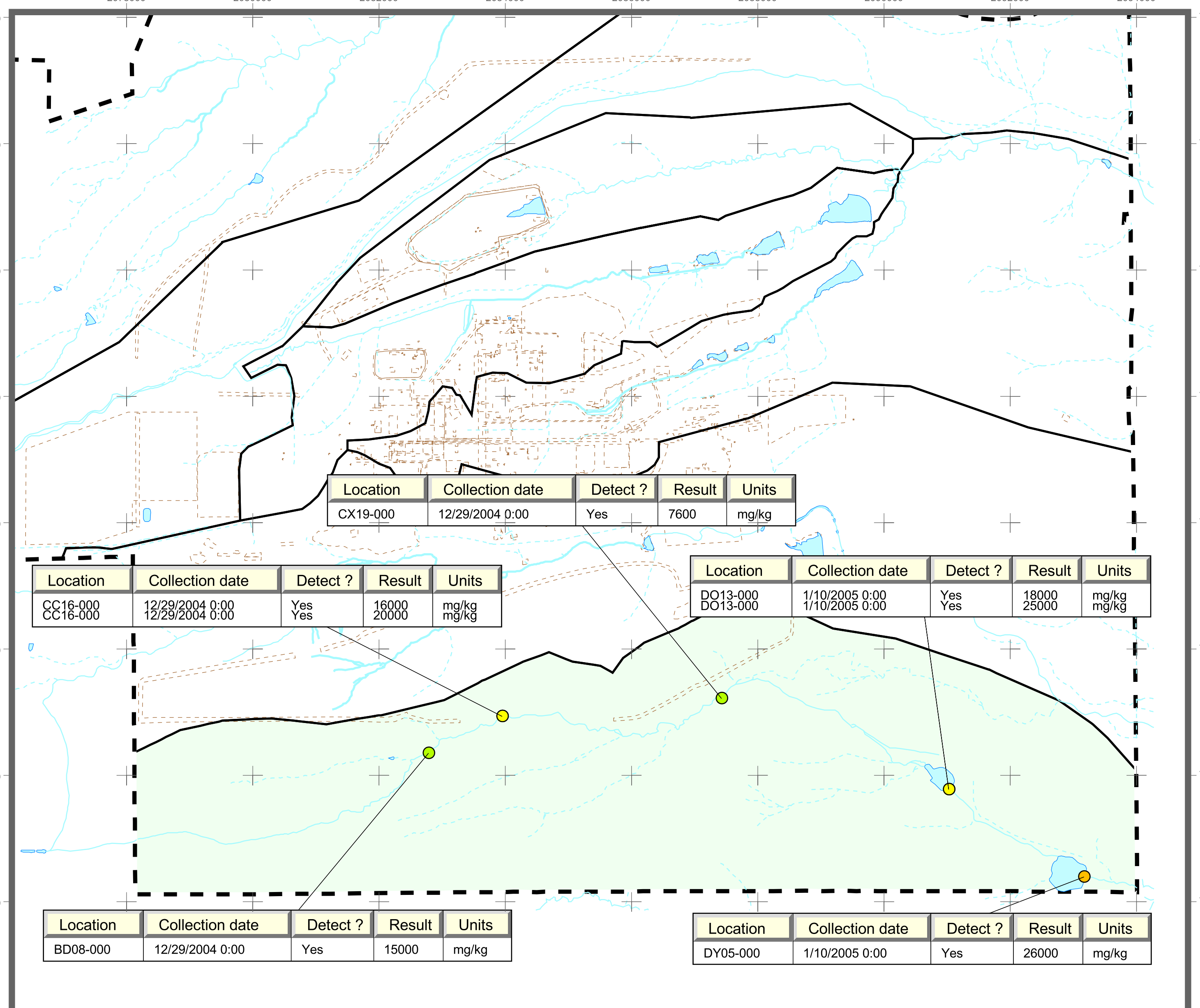


Figure A3.4.RC AEU.31 Probability Plot of Zinc Concentrations in Sediments from RC AEU.

Figure A3.4.SE AEU.1
Southeast AEU
Sediment Sampling Locations for Aluminum



Location	Collection date	Detect ?	Result	Units
CX19-000	12/29/2004 0:00	Yes	7600	mg/kg

Location	Collection date	Detect ?	Result	Units
CC16-000	12/29/2004 0:00	Yes	16000	mg/kg
CC16-000	12/29/2004 0:00	Yes	20000	mg/kg

Location	Collection date	Detect ?	Result	Units
DO13-000	1/10/2005 0:00	Yes	18000	mg/kg
DO13-000	1/10/2005 0:00	Yes	25000	mg/kg

Location	Collection date	Detect ?	Result	Units
BD08-000	12/29/2004 0:00	Yes	15000	mg/kg

Location	Collection date	Detect ?	Result	Units
DY05-000	1/10/2005 0:00	Yes	26000	mg/kg

KEY

Sampling location

- Detect >= ESL >= Maximum background
- Detect >=ESL < Maximum Background
- Detect < ESL < Maximum Background
- Nondetect

ESL = 15900 mg/kg

Maximum background = 25200 mg/kg

Standard Map Features

- Southeast AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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0 1250 2500 Feet

Scale 1:30000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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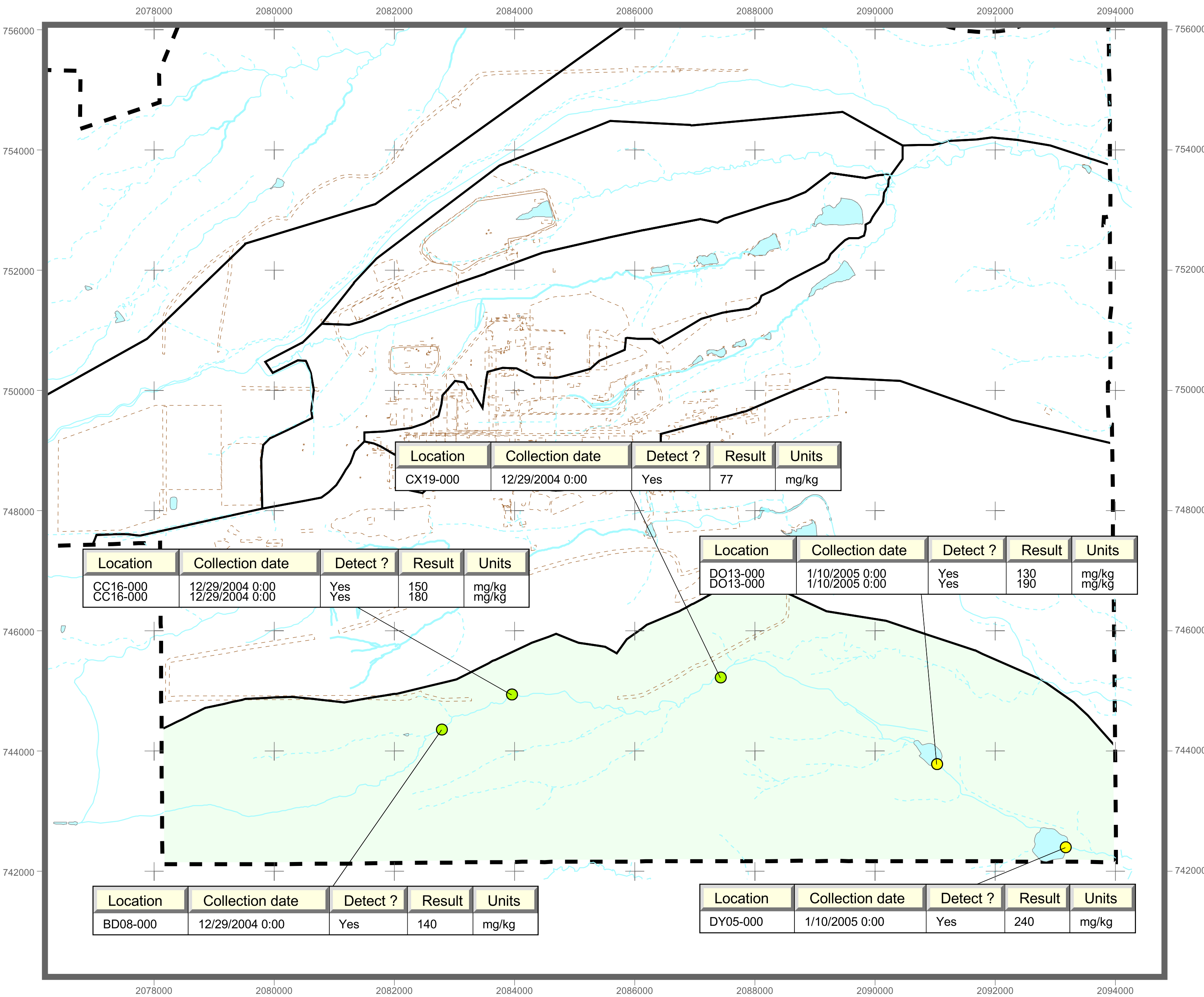
Figure A3.4.SE AEU.2
Southeast AEU
Sediment Sampling Locations
for Barium



KEY

Sampling location

- Detect >= ESL >= Maximum background
- Detect >=ESL < Maximum Background
- Detect < ESL < Maximum Background
- Nondetect

ESL = 189 mg/kg

Maximum background = 260 mg/kg

Standard Map Features

- Southeast AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1250 2500 Feet

Scale 1:30000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Technology Site

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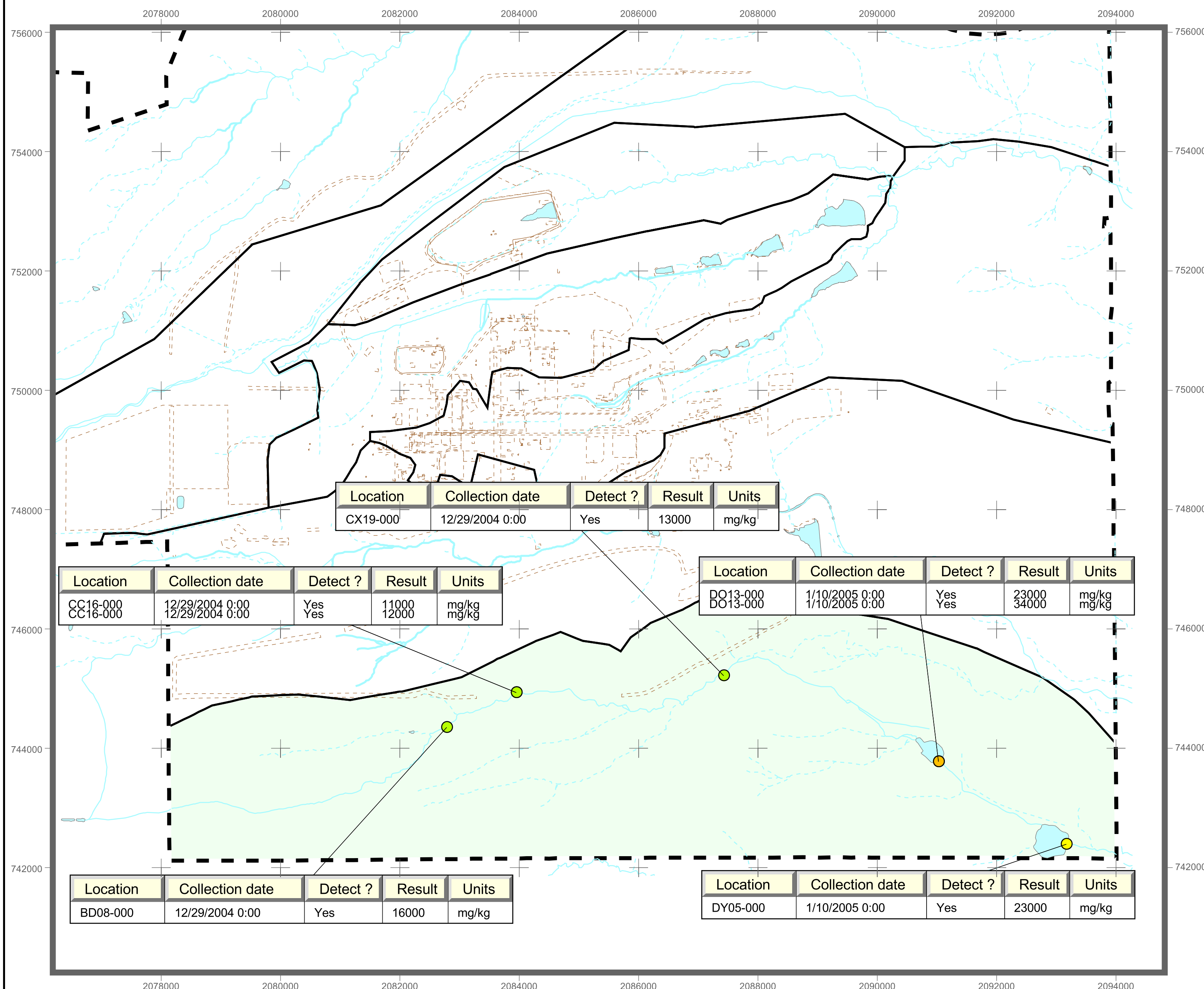
ArcView\AEU_PJ\seaeu_pj_maps.apr

Figure A3.4.SE AEU.3
Southeast AEU
Sediment Sampling Locations
for Iron



KEY

Sampling location

- Detect >= ESL >= Maximum background
- Detect >=ESL < Maximum Background
- Detect < ESL < Maximum Background
- Nondetect

ESL = 20000 mg/kg

Maximum background = 31400 mg/kg

Standard Map Features

- Southeast AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1250 2500 Feet

Scale 1:30000

State Plane Coordinate Projection
Colorado Central Zone
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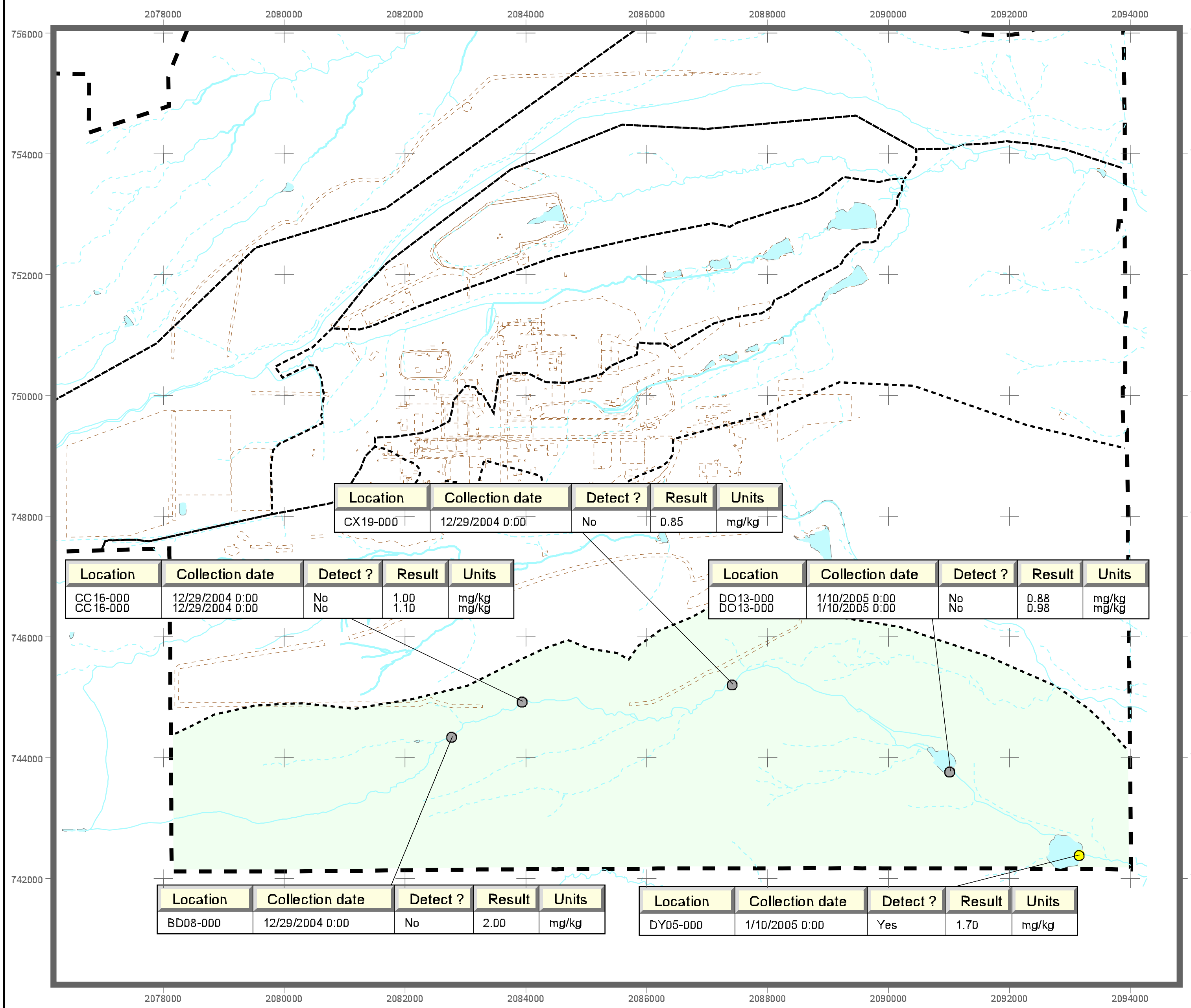
Figure A3.4.SE AEU.4
Southeast AEU
Sediment Sampling Locations for Selenium



Location	Collection date	Detect ?	Result	Units
CX19-000	12/29/2004 0:00	No	0.85	mg/kg

Location	Collection date	Detect ?	Result	Units
CC16-000	12/29/2004 0:00	No	1.00	mg/kg
CC16-000	12/29/2004 0:00	No	1.10	mg/kg

Location	Collection date	Detect ?	Result	Units
DO13-000	1/10/2005 0:00	No	0.88	mg/kg
DO13-000	1/10/2005 0:00	No	0.98	mg/kg

Location	Collection date	Detect ?	Result	Units
BD08-000	12/29/2004 0:00	No	2.00	mg/kg

Location	Collection date	Detect ?	Result	Units
DY05-000	1/10/2005 0:00	Yes	1.70	mg/kg

KEY

Sampling location

- Detect >= ESL >= Maximum background
- Detect >=ESL < Maximum Background
- Detect < ESL < Maximum Background
- Nondetect

ESL = .95 mg/kg

Maximum background = 3.2 mg/kg

Standard Map Features

- Southeast AEU
- Aquatic Exposure Unit boundary
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N S W E

0 1250 2500 Feet

Scale 1:30000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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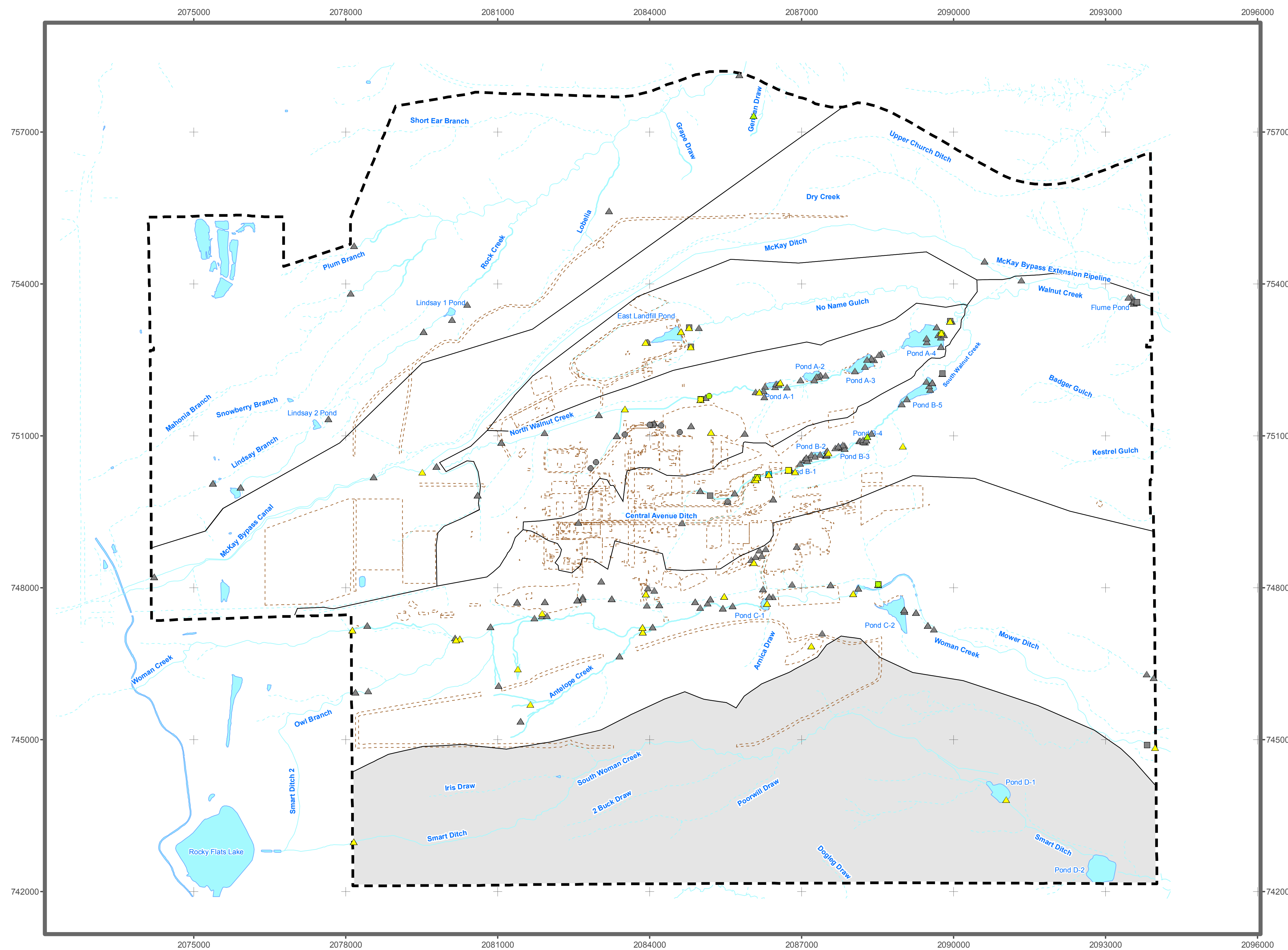

Figure A3.4.SE AEU.5

Silver (dissolved) Concentrations in Sitewide Surface Water

KEY

- Sample collected since October 1, 2000
- Sample collected between October 1, 1996 and October 1, 2000
- Sample collected between October 1, 1991 and October 1, 1996
- Concentration > Max Background MDC
- Concentration > ESL and <= Max Background MDC
- Concentration <= ESL
- Nondetect (ND)

ESL = 0.00032 mg/L
Max Background MDC = 0.002 mg/L

Standard Map Features

- Southeast AEU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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0 1,000 2,000 Feet

Scale 1:24,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Figure A3.4.SE AEU.6
Southeast Surface Water Sampling Location SW130 for Dissolved Silver

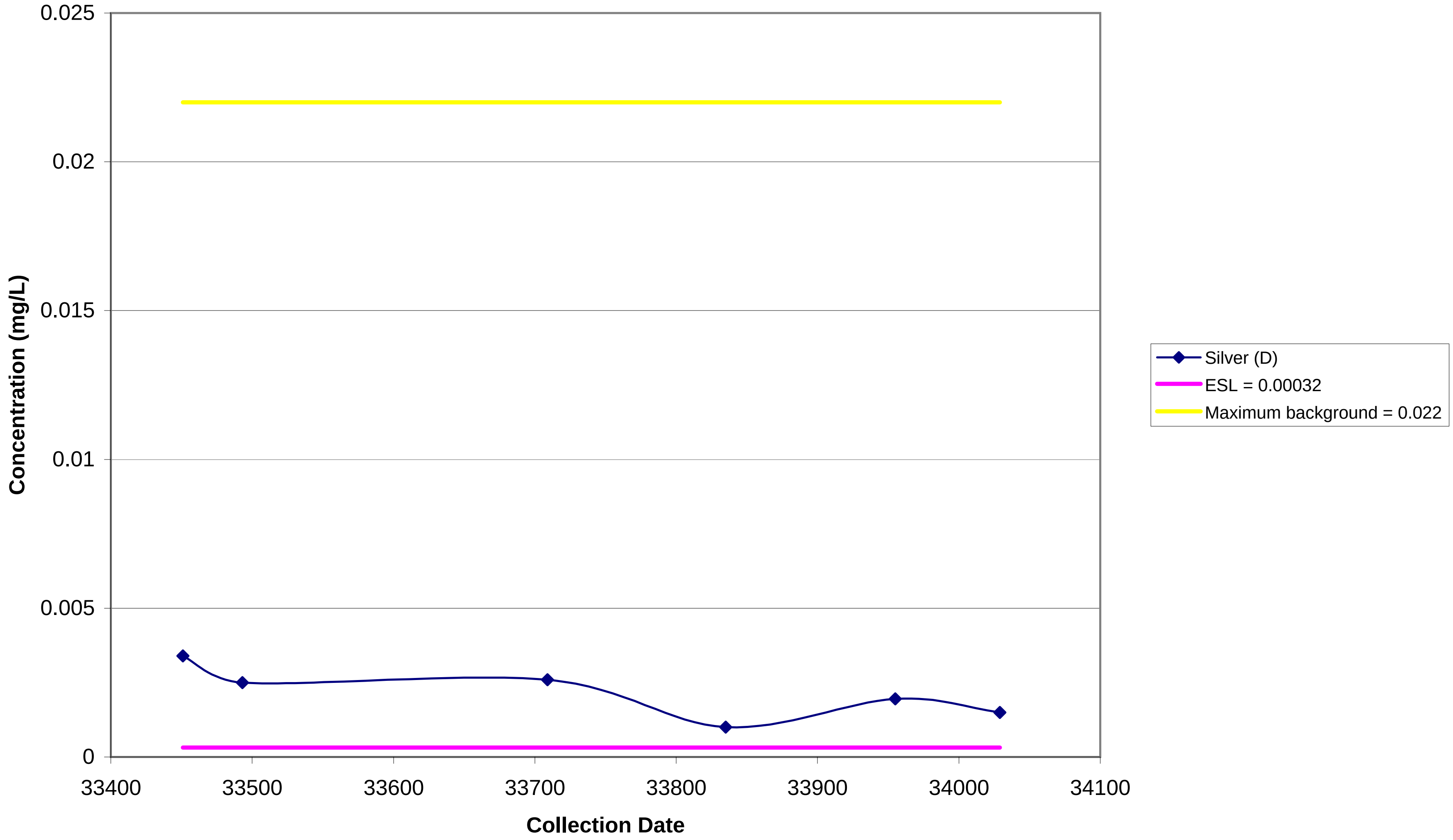
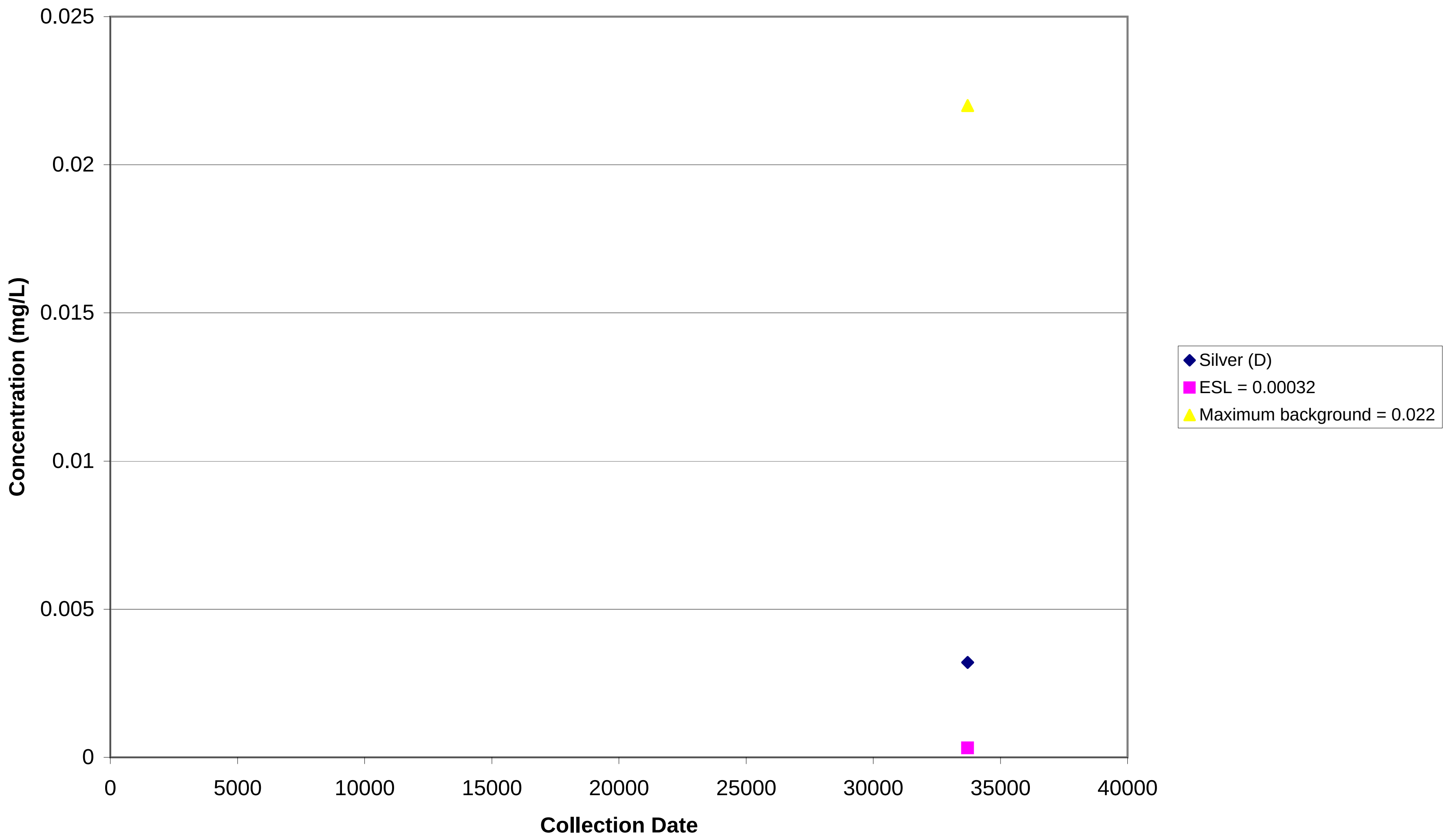


Figure A3.4.SE AEU.7
Southeast Surface Water Sampling Location D1 for Dissolved Silver



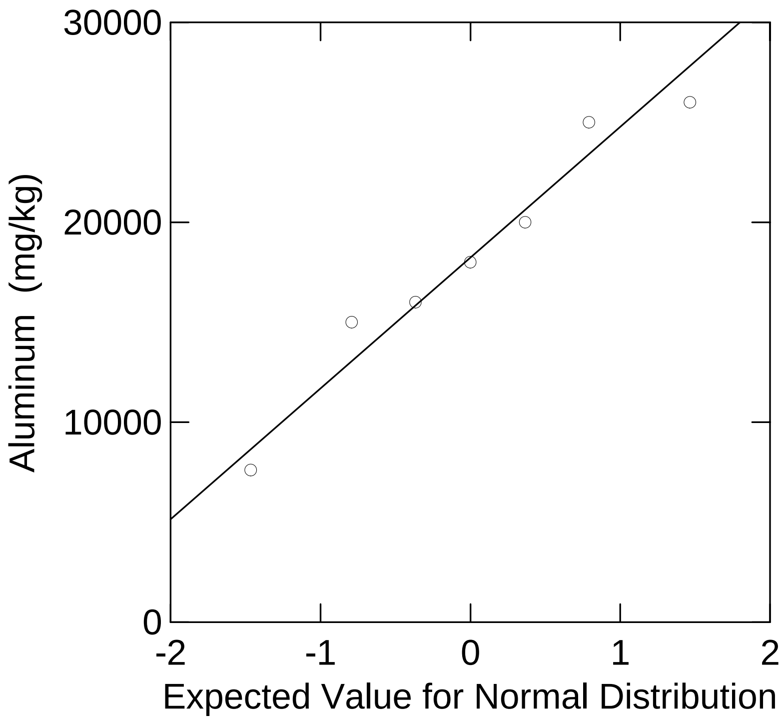


Figure A3.4.SE AEU.8 **Probability Plot of Aluminum Concentrations in Sediments from SE AEU.**

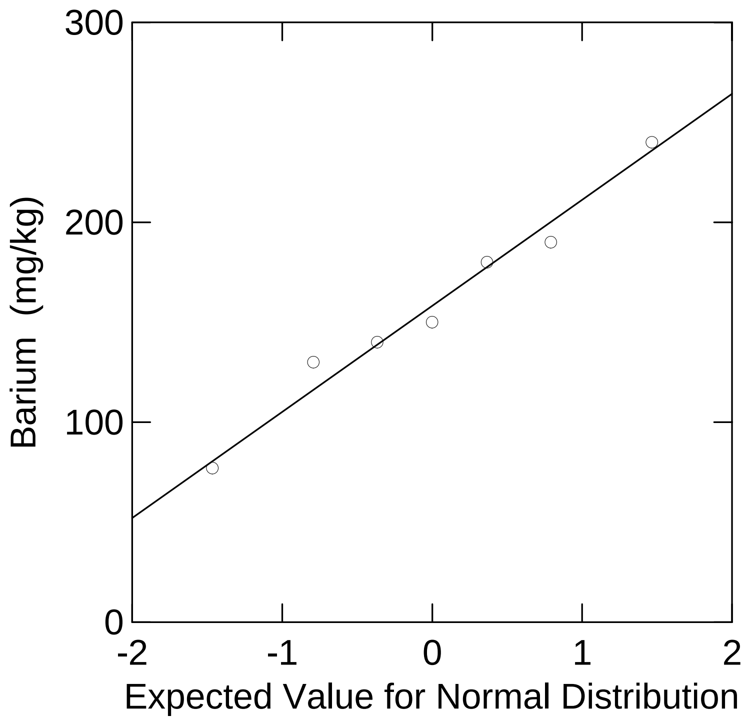


Figure A3.4.SE AEU.9 **Probability Plot of Barium Concentrations in Sediments from SE AEU.**

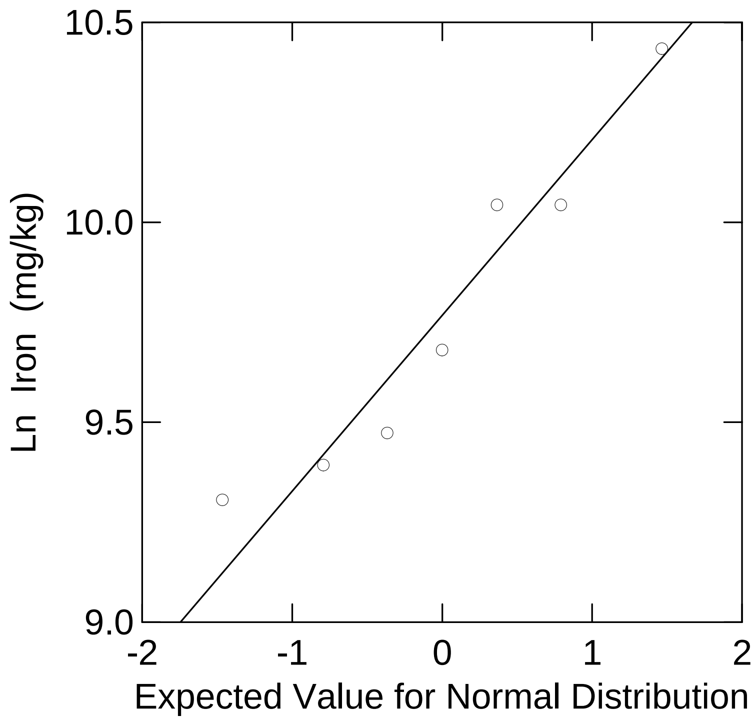


Figure A3.4.SE AEU.10 Probability Plot of Iron Concentrations (Natural Logarithm) in Sediments from SE AEU.

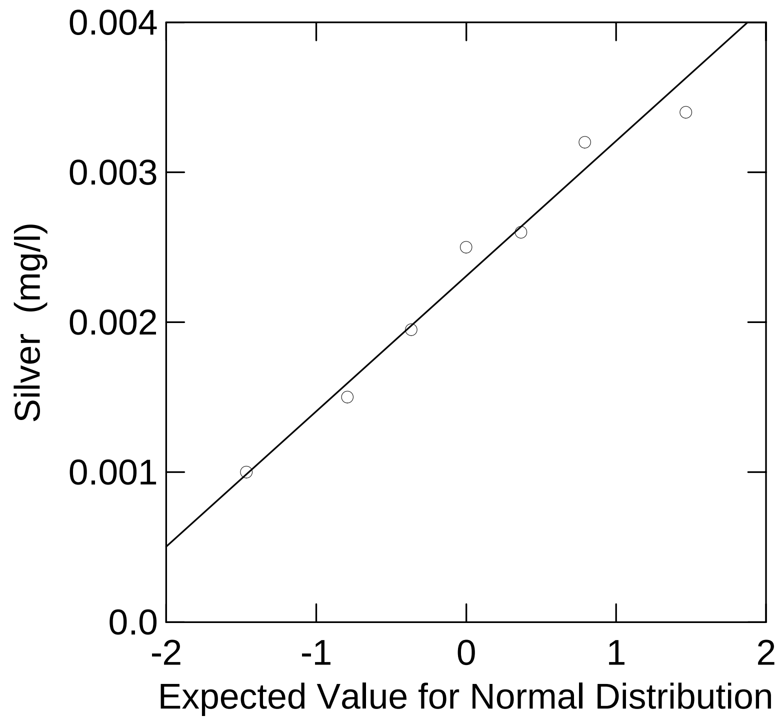


Figure A3.4.SE AEU.11 **Probability Plot of Silver Concentrations in the Surface Water from SE AEU.**

COMPREHENSIVE RISK ASSESSMENT

NO NAME GULCH AQUATIC EXPOSURE UNIT, ROCK CREEK AQUATIC EXPOSURE UNIT, MCKAY DITCH AQUATIC EXPOSURE UNIT, SOUTHEAST AQUATIC EXPOSURE UNIT

VOLUME 15B1: ATTACHMENT 4

CRA Data Set for the AEU

COMPREHENSIVE RISK ASSESSMENT

ROCK CREEK, MCKAY DITCH. NO NAME GULCH, AND SOUTHEAST AQUATIC EXPOSURE UNIT

VOLUME 15B1: ATTACHMENT 5

Site-Specific ESLs and Additional Benchmarks for Surface Water and Sediment

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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
µg	micrograms
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µm	micrometer
AEU	Aquatic Exposure Unit
AWQC	Ambient Water Quality Criteria
BCG	biota concentration guideline
CB-PEC	consensus-based probable effects concentration
CB-TEC	consensus-based threshold effects concentration
CCC	criterion continuous concentration
CCME	Canadian Council of Ministers of the Environment
CDPHE	Colorado Department of Public Health and Environment
CMC	criterion maximum concentration
CRA	Comprehensive Risk Assessment
DOE	U.S. Department of Energy
ECOI	ecological contaminant of interest
ECOPC	ecological contaminant of potential concern
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
EqP	equilibrium partitioning
ERA	Ecological Risk Assessment

ERL	effect range low
ERM	effect range median
ESL	ecological screening level
HQ	hazard quotient
ISQG	interim sediment quality guideline
LEL	lowest effect level
LOAEL	lowest observed adverse effect level
LOEC	Lowest observed effect concentration
MDC	maximum detected concentration
MENVIQ/EC	Ministere de l'Environnement du Quebec et Environnement Canada
mg	milligrams
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MIDEQ	Michigan Department of Environmental Quality
MK AEU	McKay Ditch Aquatic Exposure Unit
NIPHEP	National Institute of Public Health and Environmental Protection
NN AEU	No Name Gulch Aquatic Exposure Unit
NOEC	No observed effect concentration
NW AEU	North Walnut Creek Aquatic Exposure Unit
NYSDEC	New York State Department of Environmental Conservation
OMOE	Ontario Ministry of the Environment
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
pCi/L	picocuries per liter

PEC	probable effect concentration
PEL	probable effect level
ppm	parts per million
RC AEU	Rock Creek Aquatic Exposure Unit
RESRAD	Residual Radioactivity
RFETS	Rocky Flats Environmental Technology Site
SE AEU	Southeast Aquatic Exposure Unit
SQG	sediment quality guideline
SW AEU	South Walnut Creek Aquatic Exposure Unit
TEC	threshold effect concentration
TEF	toxic equivalency factor
TEQ	toxic equivalency quotient
TET	toxic effect threshold
TMDL	total maximum daily load
TNRCC	Texas Natural Resource Conservation Commission
UCL	upper confidence limit
UTL	upper tolerance limit
WC AEU	Woman Creek Aquatic Exposure Unit
WHO	World Health Organization

1.0 INTRODUCTION

The first step in this two-tiered risk evaluation was the initial ecological contaminant of potential concern (ECOPC) identification screening evaluation. Maximum detected concentrations (MDCs) of ecological contaminants of interest (ECOIs) at the Rocky Flats Environmental Technology Site (RFETS) were compared to conservative ecological screening level (ESL) benchmarks to eliminate ECOIs that clearly pose no risks and to identify ECOPCs for further risk evaluation.

The second step considered more realistic exposure and effects characterization of ECOPCs in the Aquatic Exposure Units (AEUs). This was done by including both surface water ESLs, which typically represent chronic water quality benchmarks, and acute water quality criteria for surface water ECOPCs. Similarly, lowest observed effects concentration (LOEC) benchmarks were identified for sediment ECOPCs.

For surface water, chronic criteria are intended to be protective of 95% of aquatic species (5-CCR-1002-31.10) and can be thought of as analogous to NOEC concentrations based on (but not limited to) survival, growth and reproduction of aquatic receptors. Long-term average exceedances of chronic criteria can be indicative of effects to sensitive genera and populations of aquatic receptors. Acute criteria are not, however, analogous to LOEC concentrations. Acute criteria are typically based on mortality endpoints over shorter periods of time than chronic criteria and exceedances of acute criteria may be indicative of potential risk to aquatic receptors.

For sediments, the use of both the lower- and upper-bound toxicity values for each ECOPC bracketed the potential for risk from each ECOPC and allowed an evaluation of the likelihood of potential risk.

Surface water and sediment ECOPCs are presented for each AEU in Tables ES.1 and ES.2, respectively, of the Executive Summary in Appendix A, Volume 15B2. Table A5.1 presents site-specific chronic ESLs and acute criteria used to evaluate surface water ECOPCs in the risk characterization process. Table A5.2 presents sediment ESLs and LOEC benchmark values for evaluating sediment ECOPCs. This attachment includes ESLs and acute or LOEC benchmark values for the Rock Creek AEU (RC AEU), McKay Ditch AEU (MK AEU), No Name Gulch AEU (NN AEU) and Southheast Drainage AEU (SE AEU). Sources, endpoints, and toxicity information used for deriving site-specific surface water ESLs and sediment LOEC benchmarks are described below.

2.0 SURFACE WATER

Original surface water ESLs, typically representing chronic water quality benchmarks, were developed in the CRA Methodology (DOE 2005a). Some of these surface water ESLs were refined to represent conditions at the RFETS using site-specific water quality considerations (i.e., pH, hardness, and temperature) where water quality affects ECOPC toxicity. This pertained to ammonia, pentachlorophenol, and several divalent metals (barium, beryllium, cadmium, chromium, copper, lead, manganese, nickel, silver, uranium, and zinc). In these cases, AEU-specific water quality parameters (Table A5.3) were used for recalculation of ESLs, referred to as refined ESLs. Acute surface water criteria, derived from acute water quality benchmarks, were also calculated using these site-specific water quality parameters (Table A5.4). In the CRA Methodology, a default hardness value equal to 100 mg/L was used to calculate hardness-dependant ESLs. The default value was reviewed against site-specific hardness values and was determined in the CRA Methodology to be an adequately conservative value for use in ECOPC identification.

Both chronic and acute values for surface water ECOPCs were consistent with regard to the type of benchmark calculated. The majority of the chronic and acute surface water values represent Ambient Water Quality Criteria (AWQC) from the Colorado Department of Public Health and Environment (CDPHE) (CDPHE 2005a). Other state and federal resources from agencies including the U.S. Environmental Protection Agency (EPA) (EPA 2002), Michigan Department of Environmental Quality (MIDEQ) (MIDEQ 2003), New York State Department of Environmental Conservation (NYSDEC) (NYSDEC 1994), and the U.S. Department of Energy (DOE) (DOE 1996) were used when Colorado-specific benchmarks were not available.

The endpoints associated with these standards are:

- Criterion continuous concentration (CCC); and
- Criterion maximum concentration (CMC).

The CCC is the chronic ambient water quality criterion protective from long-term exposures. It is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect. Chronic toxicity refers to effects through an extended time period and may be expressed in terms of an observation period equal to the lifetime of an organism or to the time span of more than one generation. Some chronic effects may be reversible; however, most are not. Chronic toxicity often is measured at sublethal endpoints associated with changes in physiological processes, reproductive impairment, reduced growth, or altered behavior. Chronic effects may be observed at the population level rather than in individuals. For example, if eggs fail to develop, reproductive fitness is reduced and the species population may be reduced or eliminated. Physiological stresses may also reduce individual health and result in a gradual population decline or absence from an area.

The CMC is recognized as being the acute ambient water quality criterion protective from short-duration exposures. It is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect. Acute standards are generally represented by higher concentrations (i.e., exposures) as compared to chronic standards. Generally, the concentrations that organisms can experience and survive is higher for short-term (i.e., acute) than for long-term (i.e., chronic) exposures. Acute toxicity refers to effects occurring in a short time period where death is often the endpoint.

Water quality standards presented in Table A5.1 are protective of aquatic life and their uses assuming the 4-day average concentration of a chemical does not exceed the CCC more than once every 3 years on average, and assuming the 1-hour average concentration does not exceed the CMC more than once every 3 years on average. Both the CCC and CMC were developed to be protective of the vast majority of aquatic communities in the United States.

2.1 CHRONIC ESL AND ACUTE CRITERION REFINEMENTS FOR INORGANIC ECOPCS

The chronic ESL for ammonia used during ECOPC selection was a default value for un-ionized ammonia (CDPHE 2005a). Concentrations of surface water ammonia from RFETS samples were reported as total aqueous ammonia (which includes both un-ionized ammonia [NH3] and ammonium [NH_4^+]) and were converted to the un-ionized fraction using AEU-specific unionized fraction percentages from EPA (1985) (e.g., 1.81 percent at pH 7.69 and 20°C at WCAEU). AEU-specific surface water quality parameters at NW AEU, SW AEU, and WC AEU for these calculations are presented in Table A5.4. The appropriate fraction of ammonia in the site samples was then compared to ESLs in the ECOPC selection.

Ammonia toxicity is temperature- and pH-dependent. Although the chronic ESL was based on a default value (0.02 mg/L) and remained unchanged, calculations for determining the acute criterion included a pH and temperature component. Acute criteria were calculated using the AEU-specific average pH and assuming a water temperature of 20°C. A temperature of 20°C is a conservative value reflective of fall, winter, and spring stream flows when water is typically present in RFETS ephemeral streams. The resulting acute criterion for un-ionized ammonia are presented in Table A5.1.

Laboratory test results indicate that toxicity for some metals is reduced by water hardness. Therefore, the refined chronic and acute ESLs for barium, beryllium, cadmium, chromium, copper, lead, manganese, nickel, silver, uranium, and zinc were derived from water hardness-based equations (EPA 2002; MIDEQ 2003; CDPHE 2005a). AEU-specific refinements for these metals were completed for the NW AEU, SW AEU, and WC AEU (Table A5.3). Site-specific hardness data are presented in Table A5.4.

2.2 CHRONIC ESL AND ACUTE CRITERION REFINEMENTS FOR ORGANIC ECOPCS

Pentachlorophenol toxicity is pH-dependent, and CDPHE (2002) guidance provided the following equations for determining site-specific acute and chronic criteria for this chemical:

- Acute = $e^{[1.005(pH) - 4.869]}$
- Chronic = $2 * e^{[1.005(pH) - 5.134]}$

AEU-specific refinements for pentachlorophenol were calculated for the NW AEU, SW AEU, and WC AEU (Table A5.3). Site-specific pH data are presented in Table A5.4. The refined chronic ESL and acute criterion for pentachlorophenol are presented in Table A5.1.

2.3 CHRONIC ESL AND ACUTE CRITERION REFINEMENTS FOR RADIONUCLIDES

The acute criterion for radium-228 (8.49 pCi/L) represents the Level 3 biota concentration guideline (BCG) for radium-228 using RESRAD-BIOTA Version 1.1 (beta) (DOE 2002). This dose is equivalent to the chronic maximum no-effect exposure of 1 rad/day (0.4 mGy/h) to the maximally exposed individual, and will be protective of aquatic organism populations (IAEA 1976). This benchmark Level 3 BCGs are radionuclide concentrations based on the benchmark dose for aquatic species, while the Level 1 BCG used to calculate the chronic ESL is based on the more radiosensitive aquatic and riparian receptors.

Radiation benchmarks were developed following an extensive review of the published literature reporting effects to aquatic organisms and was supported by more recent reviews (IAEA 1992; DOE 2005b). Species included in the determination of this criterion included fish and invertebrates of many species. The most sensitive LOEC from various life stages and endpoints of various sensitivities was selected as the maximum dose adequately protective of the population (reproduction in snails; Cooley et al. 1970). It is assumed that the diverse test conditions considered in the guideline development will also be protective of the aquatic species potentially present at RFETS.

3.0 SEDIMENT

Sediment ESLs provide a low value of no effects to threshold effects analogous to a no effect concentration (NOEC), below which effects are unlikely to occur. Upper-bound estimates of concentrations for each ECOPC, above which exists an increased potential for adverse effects, were identified in the published literature and are referred to as lowest observed effects concentration (LOEC) benchmarks. Concentrations that occur between these upper- and lower-bound values are of uncertain but potential toxicity, and population-level risks are expected to be low for concentrations in this range.

The hierarchy for identification and selection of LOEC benchmarks was as follows:

1. MacDonald et al., 2000a (organics and metals) and MacDonald et al., 2000b (PCBs) – consensus-based probable effects concentrations (CB-PECs);
2. EPA, 1997;

3. Ingersoll et al., 1996; and

4. Other literature sources.

The original sediment NOEC/threshold ESLs from the ECOPC identification process in the CRA Methodology were used in this assessment, along with LOEC benchmarks for each ECOPC. The use of these two values for each ECOPC would then bracket the estimated risk using the hazard quotient (HQ) approach. A description of the LOEC benchmark for each ECOPC is provided below, and a summary of these values is provided in Table A5.2.

The endpoints for the sediment toxicity values vary. In general, the median observed toxicity values from available studies were selected as LOEC benchmarks. When compared to the ranges reported in Table A5.2, these values represent a central tendency measure and were greater than the NOEC/threshold ESLs. The following paragraphs describe these endpoints, as identified by the investigative studies from which they were drawn.

Bolton et al., 1985. The benchmark value for fluoride was derived from this study using an equilibrium partitioning approach. The LOEC benchmark represents the chronic equilibrium partition-derived threshold concentration when organic carbon in sediment equals 1 percent.

CCME, 2002. The Canadian federal government has compiled a list of regularly updated screening environmental quality guidelines for surface water and sediments in Canada. The NOEC/threshold ESL and LOEC benchmark for total dioxins were identified in this document as:

- An interim sediment quality guideline (ISQG); and

- A probable effect level (PEL).

ISQGs were determined to provide a concentration below which effects are considered unlikely, whereas the PELs are concentrations above which adverse effects may occur. These benchmarks are generally good predictors of the likelihood of no effects or adverse effects. These benchmarks are reported in sediment dry weight derived using an effects-range approach.

The NOEC/threshold ESL (0.00085 microgram per kilogram [μg/kg]) and the LOEC benchmark (0.0215 μg/kg) for dioxins (polychlorinated dibenzo-p-dioxins and dibenzo furans) were based on the consensus toxic equivalency factors (TEFs) developed by the World Health Organization (WHO) (VanDenBerg 1998). Dioxins and furans are ECOPCs that pose a potential for additive risk to sediment-dwelling organisms. A cumulative effect is expected due to a similar mode of toxic action from different congeners. However, all halogenated and aromatic hydrocarbons with dioxin-like properties (dioxins and furan congeners) do not exert the same degree of toxicity.

Therefore, TEFs were used to normalize congener concentrations to their dioxin equivalent (Table A5.5).

Only dioxin and furans detected in at least 5 percent of sediment samples in at least one AEU were evaluated as total dioxin equivalents. The concentration of each ECOPC was multiplied by its TEF to calculate the dioxin toxic equivalency quotient (TEQ). Congeners not detected in a specific sample were not included in this calculation. All TEQs within a sample were summed, and the summed TEQ was compared to the NOEC/threshold ESL and LOEC benchmark for total dioxins (CCME 2002) presented in Table A5.2. Tier 2 statistical calculations (e.g., 95 percent upper tolerance limit [UTL] and 95 percent upper confidence limit [UCL]) were calculated using these summed TEQ concentrations derived from each sample if the summed TEQ concentrations were greater than the NOEC/threshold ESL.

Cubbage, et al., 1997. These Washington state sediment quality guidelines represent a probable apparent effects threshold approach to sediment quality value derived using MICROTOX (for acenaphthylene and for carbazole) endpoints with dry-weight values.

Ginn and Pastorak, 1992. The state of Washington has developed sediment quality standards for some polar and ionic organic compounds. These standards provide an indication that the potential for adverse effects may require additional evaluation. LOEC benchmarks for 4-methylphenol and pentachlorophenol were selected from this reference.

Ingersoll et al., 1996. Sediment-effect concentrations were developed for a suite of chemicals based on laboratory data on the toxicity of contaminants associated with field-collected sediment to the amphipod *Hyalella azteca* and the midge *Chironomus riparius*. The sediment-effect concentrations are defined as the concentrations of individual contaminants in sediment below which toxicity is rarely observed and above which toxicity is frequently observed. Two types of sediment-effect concentrations were calculated from the data:

- Effect range low (ERL); and
- Effect range median (ERM).

The ERL is the lower 10th-percentile concentration associated with observations of biological effects. According to this method, concentrations below the ERL should rarely be associated with adverse effects (EPA 1996). The ERL for total polynuclear aromatic hydrocarbons (PAHs) was used as a surrogate for the dibenzo(a,h)anthracene LOEC benchmark, for which no other LOEC benchmark value was available. The ERM represents the chemical concentration above which adverse effects would frequently occur. For the purposes of this evaluation, the reported ERLs were selected as the LOEC benchmarks for aluminum, iron, manganese, benzo(g,h,i)perylene, and indeno(1,2,3-cd)pyrene.

Jones et al., 1997. This reference provides a compilation of available sediment LOEC benchmarks and various approaches for their development. The LOEC benchmark for 2-

butanone represents a secondary chronic value for sediment derived using the EqP approach. The guidance recommends these values be used cautiously given that they are site-specific and calculated using a 1-percent organic carbon fraction.

MacDonald et al., 1999. Numeric standards for freshwater and marine, surface water, and sediment were gathered as part of a regional study contributing to the Georgia Basin Ecosystem Initiative, a federal-provincial partnership that provides a broad framework for action toward long-term sustainability in the Georgia Basin, British Columbia. Part of this effort was to determine applicable comparison standards for screening processes. Water quality, sediment quality, and tissue residue guidelines were reviewed for consideration as basic tools in evaluating environmental conditions for the development of water management strategies. This document provides a summary of all obtained, validated standards available in the literature at the time. Appendices are devoted to the summary of toxicity values by chemical and by media. The information for sediment ECOPCs was reviewed, and the range of reported screening concentrations is summarized for each chemical in Table A5.2. Consistent types of toxicity values were relied upon to represent median-level effects thresholds as compared to the range of values reported. The selected LOEC benchmarks are as follows:

- The LOEC benchmark for selenium represents a criterion in dry weight from Nagpal, et al. (1995). This was the only value available for total selenium in sediment.
- The LOEC benchmark for acenaphthene represents a PEL from Nagpal, et al. (1995).
- The LOEC benchmark values for barium and silver were derived from this guidance and represent the Texas sediment quality guideline: 85th percentile level in reservoirs, dry weight (TNRCC 1996). The barium LOEC benchmark represents the average of the observed toxicity values reviewed for this evaluation (reported range of 20 to 500 milligrams per kilogram [mg/kg]). These screening levels are based on percentile concentrations from statewide historical data and are not health or toxicity based. While the guidelines are not enforceable, they provide a basis for evaluating contaminant concentrations in media at the site to which receptors are potentially exposed.

MacDonald et al., 2000a. Numeric sediment quality guidelines (SQGs) were compiled and evaluated for metals and organic compounds. Two SQGs were identified for each chemical:

- A consensus-based threshold effect concentration (TEC); and
- A consensus-based probable effect concentration (PEC).

The TECs were determined to provide a concentration below which effects are considered unlikely, whereas the PECs are concentrations above which adverse effects are likely. These benchmarks are generally good predictors of the likelihood of no effects or adverse effects. Consensus-based TECs for sediment correctly predicated toxicity from 34.3 percent of samples for mercury (n=79) to 88.9 percent of samples for total polychlorinated biphenyls (PCBs) (n = 120), while PECs for sediment correctly predicted samples to be toxic in 77 percent of samples for arsenic (n=150) to 100 percent of samples for mercury (n = 100) for metals, PAHs, and PCBs. Thus, there is confidence that these guidelines accurately predict the potential for adverse effects except for the low SEV for mercury, where there is greater uncertainty.

MacDonald et al., 2000b. Numeric SQGs were compiled and evaluated for PCBs, and a set of comparable SQGs were identified for certain inorganic and organic chemicals. The following SQGs were identified for each congener and for total PCBs:

- A consensus-based TEC;
- A lowest effect level (LEL) concentration; and
- A toxic effect threshold (TET) concentration.

The TEC for total PCBs was determined to provide a concentration below which effects are considered unlikely. The LEL, an alternative SQG selected due to the lack of TECs for individual PCB congeners, is a numerical threshold concentration protective of 85 to 90 percent of sediment-dwelling organisms. The TET, an alternative SQG selected due to the lack of PECs for individual PCB congeners, represents concentrations above which adverse effects are likely. TETs were reported to represent concentrations above which adverse effects are expected on 90 percent of sediment-dwelling organisms. These benchmarks were designed for sediments with 1-percent organic carbon; higher proportions would be protective of receptors and increase these toxicity value concentrations.

PCBs are ECOPCs that pose a potential for additive risk to sediment-dwelling organisms. A cumulative effect from PCBs is expected due to a similar mode of toxic action from different congeners. Only PCB congeners that were detected in at least 5 percent of sediment samples in the AEU were evaluated both as individual PCBs and as total PCBs. These concentrations were evaluated against their respective NOEC/threshold ESLs and LOEC benchmarks (MacDonald, et al. 2000a and 2000b). Aroclor 1254 and/or Aroclor 1260 were the only PCB congeners detected in at least 5 percent of the sediment samples within an AEU. Concentrations of these PCBs in each sample were added to determine the total PCB concentration in the sample. Congeners not detected in a specific sample (i.e. Aroclor 1254 or Aroclor 1260) were included in this calculation with half the reported value used as a proxy concentration. Tier 1 and Tier 2 statistical calculations (e.g., 95 percent UTL and 95 percent UCL) were calculated using these total PCB concentrations derived from each sample.

The consensus-based TEC (CB-TEC) and PEC (CB-PEC) for PAHs were identified from MacDonald et al. (2000a) for use as the total PAH-NOEC/threshold ESL and LOEC benchmarks, respectively, for comparison against summed PAH concentrations. The CB-TEC (1,610 ug/kg) and CB-PEC (22,850 ug/kg) were reported to predict the absence of toxicity or the presence of toxicity in 81.5 and 100 percent of samples (n=167), respectively.

MENVIQ/EC, 1992. The value for benzo(k)fluoranthene was derived from this study and represents the sediment quality TET using a screening-level concentration approach; i.e., TET when organic carbon in sediment equals 1 percent.

NYSDEC, 1994. The value for antimony was derived from this study using a screening-level concentration approach and represents the LEL in dry weight.

EPA, 1997. These values represent a guideline or sediment quality advisory level at 1 percent organic carbon using an equilibrium partitioning (EqP) approach. Equilibrium partitioning calculations were used to calculate LOEC benchmark concentrations. Chronic surface water AWQCs were used as the basis for calculating sediment NOEC/threshold ESLs, while acute AWQCs were used as the basis for calculating sediment LOEC benchmarks, where:

$$EqP_{ESL} = ESL_{water} * Koc * foc$$

EqP = Equilibrium partitioning-based sediment ESL
ESL_{water} = Surface water ESL (chronic)
Koc = Organic carbon portioning coefficient
foc = Fraction organic carbon (assumed 1%)

$$EqP_{TT} = A_{water} * Koc * foc$$

EqP = Equilibrium partitioning-based sediment LOEC benchmark
A_{water} = Surface water acute ESL
Koc = Organic carbon portioning coefficient
foc = Fraction organic carbon (assumed 1%)

4.0 REFERENCES

Bolton, H.S., R.J. Breteler, B.W. Vigon, J.A. Scanlon, and S.L. Clark, 1985. National Perspective on Sediment Quality. Prepared for EPA Contract No. 68-01-6986. Battelle, Washington Environmental Program Office, Washington, D.C.

Canadian Council of Ministers of the Environment (CCME), 2002. Canadian Environmental Quality Guidelines. Update 2, 2002. Canadian Council of Ministers of the Environment, Winnipeg.

CDPHE, 2002, Colorado Department of Public Health and Environment; Regulation No. 38 Classifications and Numeric Standards South Platte River Basin.

CDPHE, 2005a. Colorado Department of Public Health and Environment Water Quality Control Commission. Regulation No. 31: The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31). March 22.

CDPHE, 2005b. Colorado Department of Public Health and Environment Water Quality Control Commission. Regulation No. 38: Classifications and Numeric Standards South Platte River Basin, Laramie River Basin, Republican River Basin, Smokey Hill River Basin. January 20.

Cooley, J.L. and D.J. Celson. 1970. Effects of chronic irradiation and temperature on populations of the aquatic snail Physa herterostropha, Rep. ORNL-4612, Oak Ridge National Lab.

Cubbage, J., D. Batts, and S. Breidenbach, 1997. Creation and Analysis of Freshwater Sediment Quality Values in Washington State. Publication No. 97-323a. Washington State Department of Ecology, Olympia, Washington.

DOE, 1996, Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effect on Aquatic Biota, 1996 Revision, ES/ER/TM-96/R2.

DOE. 2002. A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota. DOE-STD-1153-2002. July.

DOE, 2005a. Final Comprehensive Risk Assessment Work Plan and Methodology. Rocky Flats Environmental Technology Site, Golden, Colorado. September.

DOE, 2005b. 100-B/C Pilot Project Risk Assessment Report. Appendix C: A Review and Analysis of Ecological Dose-Effects from Radiation Exposure. External Review Draft A. DOE/RL-2005-40.

EPA, 1996, as cited within Jones et al., 1997. Calculation and Evaluation of Sediment Effect Concentrations for the Amphipod Hyalella azteca and the Midge Chironomus riparius. EPA 905-R96-008. Great Lakes National Program Office, Chicago, Illinois.

EPA, 1997. The Incidence and Severity of Sediment Contamination in Surface Waters of the U.S. Volume 1: National Sediment Quality Survey. USEPA 823-R-97-006. Office of Science and Technology. Washington, D.C.

EPA, 2002. National Recommended Water Quality Criteria: 2002. EPA-822-R-02-047. Office of Water, Office of Science and Technology, Washington, D.C.

Ginn, T.C., and R.A. Pastorak, 1992. "Assessment and Management of Contaminated Sediments in Puget Sound." Sediment Toxicity Assessment. Lewis Publishers, Boca Raton, Florida, pp. 371-401.

Ingersoll, C.G., P.S. Haverland, E.L. Brunson, T.J. Canfield, F.J. Dwyer, C.E. Henke, N.E. Kemble, D.R. Mount, and T.G. Fos, 1996. "Calculation and Evaluation of Sediment Effect Concentrations for the Amphipod Hyalella aztca and the midge Chironomus riparius." Journal of Great Lakes Research, 22(3): 602-623.

IAEA. 1976. Effects of ionizing radiation on aquatic organisms and ecosystems. IAEA Technical Report Series 172. Vienna, Austria.

IAEA. 1992. Effects of ionizing radiation on plants and animals at levels implied by current radiation protection standards. IAEA Technical Report Series 332. Vienna, Austria.

Jones, D. S., G. W. Suter II, and R. N. Hull, 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment Associated Biota. 1997 Revision, ES/ER/TM-95-R4. Prepared for the Office of Environmental Management, U.S. Department of Energy, Washington, D.C.

MacDonald, D.D., T. Berger, K. Wood, J. Brown, T. Johnsen, M.L. Haines, K. Brydges, M.J. MacDonald, S.L. Smith, and D.P. Shaw, 1999. A Compendium of Environmental Quality Benchmarks. GBEI/EC-99-001. ISBN 0-662-28624-3. Prepared for Environment Canada, Vancouver, B.C., Canada.

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger, 2000a, “Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems,” Arch. Environ. Contam. Toxicol., 39:20-31.

MacDonald, D.D., L.M. DiPinto, J. Field, C.G. Ingersoll, E.R. Long, and R.C. Schwartz, 2000b, “Development and evaluation of consensus-based sediment effect concentrations for polychlorinated biphenyls.” Environ Tox and Chem., 19(5):1403-1413.

MENVIQ/EC (Ministere de l’Environnement du Quebec et Environnement Canada), 1992. Interim Criteria for Quality Assessment of St. Lawrence River Sediment. ISBN 0-662-19849-2. St. Lawrence Action Plan. St. Lawrence Center and Ministere de l’Environnement du Quebec, Quebec City, Quebec.

Michigan Department of Environmental Quality (MIDEQ), 2003. Rule 57: Water Quality Values. February.

Nagpal, N.K., L.W. Pommen, and L.G. Swain, 1995. Approved and Working Criteria for Water Quality. ISBN 0-7726-2522-0. Water Quality Branch, Ministry of Environment, Lands and Parks. Victoria, British Columbia.

New York State Department of Environmental Conservation. NYSDEC, 1994, Technical Guidance for Screening Contaminated Sediments. Division of Fish and Wildlife, Division of Marine Resources, Albany, New York.

Texas Natural Resource Conservation Commission (TNRCC), 1996. The Surface Water Quality Monitoring Program Supplementary Information Manual, Statewide Percentile Report. Water Planning and Assessment Division, Texas Natural Resource Conservation Commission, Austin, Texas.

U.S. Environmental Protection Agency (EPA), 1985. Agency. *Ambient Water Quality Criteria for Ammonia*, (EPA 440/5-85-001). January.

Van den Berg, M. L. Birnbaum, A.T.C. Bosveld, B. Brunstron, P. Cook, M. Feeley, J.P Fiesy, A. Hanberg, R. Hasegawa, S.W. Kennedy, T. Kubiak, J.C. Larsen, A.K. Djen Liem, C. Nolt, R.E. Peterson, L. Poellinger, S. Safe, D. Schrenk, D. Tillit, M. Tysklind, M. Younes, F. Waern, and T. Zacharewski, 1998. Toxic Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs for Humans and Wildlife. Environ. Health Perspectives, Vol. 106, No. 12, pp. 775-791.

TABLES

Table A5.1
Chronic ESLs and Acute Criteria for Surface Water ECOPCs

ECOPC	Units	Sitewide ESL	Sitewide Acute	No Name ESL	No Name Acute	Rock Creek ESL	Rock Creek Acute	McKay ditch ESL	McKay ditch Acute	Southeast ESL	Southeast Acute	Reference
Inorganic												
Aluminum (T)	µg/L	87	750	Same as sitewide								CDPHE 2005a
Ammonia (unionized)	µg/L	20	181	20	162	20	146	20	95	20	181	CDPHE 2005a
Barium (T)	µg/L	1027	5859	1204	6870	438	2498	214	1221	438	2498	MIDEQ 2003
Cadmium (D)	µg/L	0.43	4.4	0.48	5.08	0.25	2.01	0.15	1.05	0.25	2.01	CDPHE 2005a
Iron (T)	µg/L	1,000	N/A	Same as sitewide								CDPHE 2005a
Lead (D)	µg/L	5.95	152.8	6.97	178.9	2.52	64.6	1.2	31	2.52	64.6	CDPHE 2005a
Selenium (D)	µg/L	4.6	18.4	Same as sitewide								CDPHE 2005a
Silver (D)	µg/L	1.27	8.06	1.65	10.4	0.32	2.03	0.10	0.64	0.32	2.03	CDPHE 2005a
Zinc (D)	µg/L	233	231	262	265	117	118	67	67	117	118	CDPHE 2005a
Organic												
bis(2-ethylhexyl)phthalate	µg/L	28.5	285	Same as sitewide								MIDEQ 2003
Di-n-butylphthalate	µg/L	9.7	75	Same as sitewide								MIDEQ 2003
Phenanthrene	µg/L	2.4	43	Same as sitewide								MIDEQ 2003
Phenol	µg/L	2,560	10,200	Same as sitewide								CDPHE 2005a

[a] RESRAD-BIOTA version 1.1 (beta) used to derive acute criterion for radionuclides.
Hardness-dependant criteria were calculated based on mean site-specific hardness values.
Site -specific water qualtiy parameters presented in Table A5.3.
Ammonia acute criteria (CDPHE 2005a) were calculated based on site-specific pH and temperature = 20°C.
N/A = Not applicable or not available.
(T) = Total
(D) = Dissolved

Table A5.2
NOEC/Threshold ESLs and LOECs for Sediment ECOPCs

ECOPC	Units	Reported Range of Benchmarks [1]	NOEC ESL	Reference	Type of Value	LOEC	Reference	Type of Value
Inorganics								
Aluminum	mg/kg	15,900 – 58,000	15,900	MacDonald et al., 1999	SQG	58,000	Ingersoll et al., 1996	ERM
Antimony	mg/kg	2 – 500	2	MacDonald et al., 1999	SQG	3.2	NYSDEC, 1994	SLCA
Arsenic	mg/kg	3 – 150	9.79	MacDonald et al., 2000a	CB-TEC	33	MacDonald et al., 2000a	CB-PEC
Barium	mg/kg	20 – 500	189	MacDonald et al., 1999	SQG	287	MacDonald et al., 1999	SQG
Cadmium	mg/kg	0.2 – 30	0.99	MacDonald et al., 2000a	CB-TEC	4.98	MacDonald et al., 2000a	CB-PEC
Chromium	mg/kg	6.25 – 600	43.4	MacDonald et al., 2000a	CB-TEC	111	MacDonald et al., 2000a	CB-PEC
Fluoride	mg/kg	0.01 – 96	0.01	MacDonald et al., 1999	ERL	7	Bolton et al., 1985	TET
Iron	mg/kg	20,000 – 290,000	20,000	MacDonald et al., 1999	LEL	280,000	Ingersoll et al., 1996	ERM
Lead	mg/kg	23 – 720	35.8	MacDonald et al., 2000a	CB-TEC	128	MacDonald et al., 2000a	CB-PEC
Nickel	mg/kg	5 – 100	22.7	MacDonald et al., 2000a	CB-TEC	48.6	MacDonald et al., 2000a	CB-PEC
Selenium	mg/kg	0.95 – 5	0.95	MacDonald et al., 1999	SQG	1.73	MacDonald et al., 1999	SQG
Silver	mg/kg	0.5 - 4.5	1	Long et al., 1995	ERL	1.6	MacDonald et al., 1999	SQG
Zinc	mg/kg	50 – 3200	121	MacDonald et al., 2000a	CB-TEC	459	MacDonald et al., 2000a	CB-PEC
Organics								
2-Butanone	µg/kg	270	84.2	EPA 1997b	EqP based	270	Jones et al., 1997	EqP based SCV
4-Methylphenol	µg/kg	12.3 - 670	12.3	EPA,1997b	EqP based	670	Ginn and Pastorak, 1992	WS-SQS
Benzo(a)anthracene	µg/kg	108-1050	108	MacDonald et al., 2000a	CB-TEC	1,050	MacDonald et al., 2000a	CB-PEC
Benzo(a)pyrene	µg/kg	9.6 – 450,000	150	MacDonald et al., 2000a	CB-TEC	1,450	MacDonald et al., 2000a	CB-PEC
Benzo(g,h,i)perylene	µg/kg	10.4 – 21,000	13	MacDonald et al., 1999	ERL	280	Ingersoll et al., 1996	ERM
Chrysene	µg/kg	8.6 – 11,500	166	MacDonald et al., 2000a	CB-TEC	1,290	MacDonald et al., 2000a	CB-PEC
Indeno(1,2,3-cd)pyrene	µg/kg	10.4 – 6,000,000	17	MacDonald et al., 1999	TEL	250	Ingersoll et al., 1996	ERM
Pentachlorophenol	µg/kg	255 - 360	255	EPA 1997	EqP based	360	Cubbage et al., 1997	WS-SQS
Phenanthrene	µg/kg	6.8 – 210,000	204	MacDonald et al., 2000a	CB-TEC	1,170	MacDonald et al., 2000a	CB-PEC
Pyrene	µg/kg	7.6 – 85,000	195	MacDonald et al., 2000a	CB-TEC	1,520	MacDonald et al., 2000a	CB-PEC
Total PAHs	µg/kg	200 – 700,000	1610	MacDonald et al., 2000a	CB-TEC	22800	MacDonald et al., 2000a	CB-PEC

[1] Range of benchmarks is derived from McDonald et al. 1999 and presented values.

The hierarchy of use of the LOECs was as follows: MacDonald et al., 2000a,b as a preference: others (EPA, 1997b; Ingersoll et al., 1996 etc) have no preference as compared to each other.
The best available, most appropriate value is reported as the LOEC value.

CB-PEC = consensus-based probable effect concentration.

CB-TEC = consensus-based threshold effect concentration.

EqP = SW ESL * Koc * foc ; foc estimated at 1%.

ERL = Effects Range Low.

ERM = Effects Range Moderate.

LEL = Lowest Effect Level.

SCV = secondary chronic value.

SQG = Sediment Quality Guideline.

TEL = Threshold Effects Level.

TET = Toxic Effect Threshold at 1% OC.

WS-SQS = Washington State Sediment Quality Standard.

Table A5.3

Site-Specific Chronic ESL and Acute Criterion Calculations

		Sitewide		No Name Gulch		McKay Ditch							
Analyte	**Units**	**ESL (Chronic)**	**Acute Criteria**	**ESL (Chronic)**	**Acute Criteria**	**ESL (Chronic)**	**Acute Criteria**	**CF_c**	**M_a**	**B_a**	**M_c**	**B_c**	**Source**
Ammonia (un-ionized)	mg/L	0.02	0.181	0.02	0.162	0.02	0.095	N/A	N/A	N/A	N/A	N/A	CDPHE 2005a
Barium, Total	µg/L	1027	5,859	1204	6,870	214	1,221	N/A	1.0629	1.1869	1.0629	2.9285	MIDEQ 2002
Cadmium, Dissolved	µg/L	0.43	4.39	0.48	5.08	0.15	1.05	0.9122	1.0166	-3.924	0.7409	-4.719	EPA 2002
Lead, Dissolved	µg/L	5.95	152.8	6.97	178.9	1.20	31	0.6801	1.273	-1.46	1.273	-4.705	CDPHE 2005a
Silver, Dissolved	µg/L	1.27	8.06	1.65	10.43	0.10	0.64	N/A	1.72	-6.52	1.72	-9.06	CDPHE 2005a
Zinc, Dissolved	µg/L	233	231	265	262	67	66	0.986	0.8473	0.8618	0.8473	0.8699	CDPHE 2005a

Site-specific water quality parameters are provided in Table A5.4

Ammonia criteria based on one-hr (acute) and 30-day average (chronic ESL) concentrations in mg/L not exceeded more than once every 3 yrs on average. In addition, the highest 4-

Acute (dissolved) = exp(Ma[ln(hardness)]+Ba)*(CF).

Chronic ESL (dissolved) = exp(Mc[ln(hardness)]+Bc)*(CF).

Acute (total) = exp(Ma[ln(hardness)]+Ba).

Chronic ESL (total) = exp(Mc[ln(hardness)]+Bc).

Where CF = metal specific total to dissolved conversion factor

N/A = Not available.

Table A5.4
Water Quality Parameters for Rocky Flats AEUs

AEU/Analyte	Number of Samples	Minimum Value	Maximum Value	Mean Value	Standard Deviation
Sitewide					
pH	982	4.6	11.7	**7.7**	0.6
Fraction of un-ionized ammonia in total aqueous ammonia (%)	N/A	N/A	N/A	**1.91**	N/A
Hardness (mg/L)	945	0.1	850	**223**	124
No Name Gulch AEU					
pH	51	6.4	8.9	**7.6**	0.6
Fraction of un-ionized ammonia in total aqueous ammonia (%)	N/A	N/A	N/A	**1.44**	N/A
Total organic carbon (mg/L)	31	1.8	51	18.2	12.1
Hardness (mg/L)	58	5	576	**259**	128
McKay Ditch					
pH	14	6.8	7.57	**7.1**	0.2
Fraction of unionized ammonia in total aqueous ammonia (%)	N/A	N/A	N/A	**0.55**	N/A
Total organic carbon (mg/L)	N/A	N/A	N/A	N/A	N/A
Hardness (mg/L)	4	46	57	**51**	5
Rock Creek					
pH	52	6.8	8.6	**7.5**	0.4
Fraction of unionized ammonia in total aqueous ammonia (%)	N/A	N/A	N/A	**1.13**	N/A
Total organic carbon (mg/L)	N/A	N/A	N/A	N/A	N/A
Hardness (mg/L)	13	23	140	**100**	34
Southeast					
pH	N/A	N/A	N/A	N/A	N/A
Fraction of unionized ammonia in total aqueous ammonia (%)	N/A	N/A	N/A	N/A	N/A
Total organic carbon (mg/L)	N/A	N/A	N/A	N/A	N/A
Hardness (mg/L)	N/A	N/A	N/A	N/A	N/A

Fraction of un-ionized ammonia calculated using an equation derived from the values presented in USEPA (1985) between pH 7 and 8 at 20°C.
N/A = Not available.

Table A5.5

TEFs for Dioxins and Furans

Dioxin Congener	Aquatic TEF[b]
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.001
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01
Heptachlorodibenzofuran[a]	0.01
Heptachlorodibenzo-p-dioxin [a]	0.001
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.5
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.01
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.01
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1
Hexachlorodibenzofuran [a]	0.1
Hexachlorodibenzo-p-dioxin [a]	0.5
1,2,3,7,8-Pentachlorodibenzofuran	0.05
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1
2,3,4,7,8-Pentachlorodibenzofuran	0.5
Pentachlorodibenzofuran [a]	0.5
Pentachlorodibenzo-p-dioxin [a]	1
2,3,7,8-Tetrachlorodibenzodioxin	1
2,3,7,8-Tetrachlorodibenzofuran	0.05
Tetrachlorodibenzo-p-dioxin [a]	1
Octachlorodibenzofuran	0.0001
Octachlorodibenzo-p-dioxin	0.0001

[a] The highest TEF within the series was assigned for results listed as generic dioxin/furan.
Source:Van den Berg et al. (1998).

COMPREHENSIVE RISK ASSESSMENT

NO NAME GULCH AQUATIC EXPOSURE UNIT, ROCK CREEK AQUATIC EXPOSURE UNIT, MCKAY DITCH AQUATIC EXPOSURE UNIT, SOUTHEAST AQUATIC EXPOSURE UNIT

VOLUME 15B1: ATTACHMENT 6

Chemical Risk Characterization Lines of Evidence in Support of the Risk Characterization

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ACRONYMS AND ABBREVIATIONS

AEU	Aquatic Exposure Unit
bgs	below ground surface
CRA	Comprehensive Risk Assessment
ECOPC	ecological contaminant of potential concern
EPC	exposure point concentration
ESL	ecological screening level
MK AEU	McKay Ditch Aquatic Exposure Unit
NN AEU	No Name Gulch Aquatic Exposure Unit
PAH	Polycyclic aromatic hydrocarbon

1.0 CHEMICAL RISK CHARACTERIZATION LINE OF EVIDENCE METHODS

The identified surface water and sediment ecological contaminants of potential concern (ECOPCs) were carried into the risk characterization process, and several data sets were generated in order to better understand current exposure conditions. Surface water data sets were queried to develop "post-1999" data summaries, and sediment samples were summarized as a surface sediment (0 to 6 inches deep) data set. An additional data interpretation involved the evaluation of adjacent surface soils as potential, future erosional contributions to aquatic habitats.

1.1 Surface Water

The Aquatic Exposure Unit (AEU) surface water ECOPC selection process relied upon the comprehensive data sets gathered from all samples collected from June 28, 1991 to August 2005. Given that water quality and chemical loading conditions are dynamic and affected by variables of site releases, accelerated action efforts, flow, environmental buffering capacity, etc., it was determined that a data set reflective of more current conditions could provide more realistic evaluation of surface water ECOPC chemistry. Therefore, summary statistics were generated for surface water data limited to samples collected post-1999.

The post-1999 surface water data sets were statistically compared to background concentrations. Summary statistics and results of the background screen are provided for the No Name Gulch AEU (NN AEU) in Tables A6.1 through A6.5 and the McKay Ditch AEU (MK AEU) in Tables A6.6 through A6.8.

1.2 Sediment

The AEU sediment ECOPC selection process relied upon the comprehensive data sets that included sediment samples collected from all depth fractions. Certain samples were collected from depths of over 9 feet below ground surface (bgs), which is not a relevant exposure media for aquatic life receptors. In contrast, data limited to surface sediments is more representative of the exposure media for aquatic species. As an additional line of evidence reflective of sediment with the potential for a complete exposure pathway to sediment receptors, all samples gathered from "surface" sediment (the top 6 inches) were evaluated. Surface sediment concentrations of ECOPCs identified in the Comprehensive Risk Assessment (CRA) were compared to ecological screening levels (ESLs). These data more accurately describe the realistic exposure conditions within an AEU. The results of the surface sediment data set were statistically summarized, and results are presented in Table 6.9 for the NN AEU and Table 6.10 for the MK AEU.

1.3 Adjacent Surface Soils

Surface soils do not provide a direct exposure pathway to aquatic receptors. However, surface soils can potentially erode into adjacent waterways via overland transport (runoff), in which case they may contribute to the future chemical makeup of the AEUs. In the interest of being conservative, adjacent surface soils (defined as any surface soil sample collected within 20 feet of the wetted edge of an AEU aquatic feature) were evaluated by comparing sediment ECOPC concentrations to surface soil concentrations. If, for example, cadmium were identified as a sediment ECOPC, then cadmium in adjacent surface soils was evaluated to determine if the concentrations were greater than the sediment ESL. If the soil result was greater, then a potential for future contribution from soil to sediment was considered to exist. Conversely, if the soil concentration was less than the ESL, then potential future sediment chemical concentrations may be diluted through natural drainage erosion. The data for adjacent surface soils were summarized for the NN AEU and MK AEU (Tables A6.11 and A6.12, respectively).

1.4 Total PAHs

Polycyclic aromatic hydrocarbons (PAHs) exert toxicity in an additive manner because of a similar mode of toxic action (narcosis). Additional data evaluation in risk characterization included an evaluation of these organic contaminants to account for this interaction. The total PAH concentrations were calculated for samples from an AEU if any individual PAHs were retained as ECOPCs for risk characterization.

1. The sum of PAHs was determined for each sample, using the reported values for the detected PAHs and half the detection limit for nondetected PAHs.
2. The maximum total PAH value was compared to the “total PAH” ESL.
3. The total detected PAHs for each sample was calculated for surface water and sediment and compared to the ESL.

This conservative measure of assessment was conducted for the NN AEU and the MK AEU. For NN AEU, the PAHs were analyzed for in the surface water and the sediment media, while only the sediment in the MK AEU was analyzed for the PAHs. Seven individual PAHs exceeded the ESL in the NN AEU sediments while two PAHs exceeded the ESL in the NN AEU surface water. There were no exceedances of the sediment ESL in the MK AEU. The potential for risk to benthic organisms was further evaluated in risk characterization (Section 5). The Total PAH values and total detected PAH values for the NN AEU are provided in Tables A6.13 through A6.16.

TABLES

Table A6.1
Summary of Post-1999 ECOI Data for Surface Water in the NN AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Inorganic (Dissolved) (mg/L)										
Arsenic	0	1	0	0.00260	-	0.00260	0	0	0.00130	0
Cadmium	0	1	0	1.90E-04	-	1.90E-04	0	0	9.50E-05	0
Chromium	0	1	0	5.30E-04	-	5.30E-04	0	0	2.65E-04	0
Copper	0	1	0	7.50E-04	-	7.50E-04	0	0	3.75E-04	0
Lead	0	1	0	0.00120	-	0.00120	0	0	6.00E-04	0
Manganese	1	1	100		N/A		1.20	1.20	1.20	0
Mercury	0	1	0	1.40E-05	-	1.40E-05	0	0	7.00E-06	0
Nickel	1	1	100		N/A		0.00600	0.00600	0.00600	0
Selenium	0	1	0	0.00230	-	0.00230	0	0	0.00115	0
Silver	0	1	0	2.60E-04	-	2.60E-04	0	0	1.30E-04	0
Thallium	0	1	0	0.00240	-	0.00240	0	0	0.00120	0
Uranium	0	1	0	0.00550	-	0.00550	0	0	0.00275	0
Zinc	1	1	100		N/A		0.0140	0.0140	0.0140	0
Inorganic (Total) (mg/L)										
Aluminum	24	24	100		N/A		0.0169	55.4	6.95	13.4
Ammonia	1	1	100		N/A		1.50	1.50	1.50	0
Antimony	8	24	33.3	5.50E-04	-	0.00190	5.90E-04	0.00190	7.11E-04	4.76E-04
Barium	24	24	100		N/A		0.0844	0.820	0.187	0.158
Beryllium	12	24	50	2.00E-05	-	2.40E-04	3.00E-05	0.00250	3.25E-04	6.30E-04
Calcium	24	24	100		N/A		19.7	150	57.4	26.3
Cobalt	15	24	62.5	1.50E-04	-	2.70E-04	1.60E-04	0.0123	0.00155	0.00302
Iron	24	24	100		N/A		0.0459	76	8.21	17.7
Lithium	24	24	100		N/A		0.00620	0.0456	0.0149	0.0108
Magnesium	24	24	100		N/A		4.54	39.9	11.8	8.27
Molybdenum	21	24	87.5	4.20E-04	-	0.00220	6.10E-04	0.00410	0.00136	8.39E-04
Potassium	23	24	95.8	3.88	-	3.88	1.67	10	3.61	2.06
Sodium	24	24	100		N/A		4.77	87	28.7	21.0
Strontium	24	24	100		N/A		0.106	0.980	0.323	0.178
Vanadium	21	24	87.5	1.20E-04	-	0.00140	5.40E-04	0.0951	0.0131	0.0233
Organic (Total) (ug/L)										

Table A6.1
Summary of Post-1999 ECOI Data for Surface Water in the NN AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
2-Methylnaphthalene	1	2	50	10.6	-	10.6	6.20	6.20	5.75	0.636
Acenaphthene	1	2	50	10.6	-	10.6	2.70	2.70	4	1.84
Fluorene	1	2	50	10.6	-	10.6	2.60	2.60	3.95	1.91
Naphthalene	1	6	16.7	1	-	1	12	12	2.42	4.69
Phenanthrene	1	2	50	10.6	-	10.6	3.50	3.50	4.40	1.27
Phenol	1	2	50	10.6	-	10.6	3.50	3.50	4.40	1.27
Total PAHS	1	6	16.7	0.500	-	80	20.8	20.8	27.1	41.3
Radionuclides (Total) (pCi/L)										
Americium-241	23	23	100	N/A			-0.00600	0.0240	0.00363	0.00797
Plutonium-239/240	23	23	100	N/A			-0.00200	0.0560	0.00726	0.0158
Uranium-233/234	23	23	100	N/A			0.327	3.79	1.57	0.861
Uranium-235	23	23	100	N/A			0.0150	0.338	0.0677	0.0658
Uranium-238	23	23	100	N/A			0.266	2.98	1.28	0.704

[a] Values in this column represent reported results for U-qualified data (i.e., nondetects).

[b] For organics and inorganics, statistics are computed using one-half the reported result for nondetects.

[c] All radionuclide values are considered detects.

Table A6.2
Statistical Distribution and Comparison to Background for Surface Water, Dissolved Analyses (excluding background samples) - 2000 - 2005 Data NN AEU

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test		
		Background			NN AEU (excluding background samples)			Test	1 - p	>Bkg
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Aluminum	mg/L	138	NONPARAMETRIC	46	1	N/A	100	WRS	N/A	N/A
Antimony	mg/L	137	NONPARAMETRIC	15	1	N/A	0	N/A	N/A	N/A
Arsenic	mg/L	129	NONPARAMETRIC	5	1	N/A	0	N/A	N/A	N/A
Barium	mg/L	140	NONPARAMETRIC	68	1	N/A	100	WRS	N/A	N/A
Beryllium	mg/L	134	NONPARAMETRIC	3	1	N/A	0	N/A	N/A	N/A
Cadmium	mg/L	136	NONPARAMETRIC	7	1	N/A	0	N/A	N/A	N/A
Calcium	mg/L	141	NONPARAMETRIC	100	1	N/A	100	WRS	N/A	N/A
Chromium	mg/L	136	NONPARAMETRIC	5	1	N/A	0	N/A	N/A	N/A
Cobalt	mg/L	139	NONPARAMETRIC	4	1	N/A	100	N/A	N/A	N/A
Copper	mg/L	138	NONPARAMETRIC	33	1	N/A	0	N/A	N/A	N/A
Iron	mg/L	137	LOGNORMAL	80	1	N/A	100	WRS	N/A	N/A
Lead	mg/L	133	NONPARAMETRIC	24	1	N/A	0	N/A	N/A	N/A
Lithium	mg/L	134	NONPARAMETRIC	34	1	N/A	100	WRS	N/A	N/A
Magnesium	mg/L	141	NONPARAMETRIC	82	1	N/A	100	WRS	N/A	N/A
Manganese	mg/L	139	LOGNORMAL	81	1	N/A	100	WRS	N/A	N/A
Mercury	mg/L	135	NONPARAMETRIC	7	1	N/A	0	N/A	N/A	N/A
Molybdenum	mg/L	139	NONPARAMETRIC	14	1	N/A	0	N/A	N/A	N/A
Nickel	mg/L	134	NONPARAMETRIC	7	1	N/A	100	N/A	N/A	N/A
Potassium	mg/L	134	NONPARAMETRIC	66	1	N/A	100	WRS	N/A	N/A
Selenium	mg/L	133	NONPARAMETRIC	8	1	N/A	0	N/A	N/A	N/A
Silver	mg/L	141	NONPARAMETRIC	6	1	N/A	0	N/A	N/A	N/A
Sodium	mg/L	141	NONPARAMETRIC	99	1	N/A	100	WRS	N/A	N/A
Strontium	mg/L	139	NONPARAMETRIC	76	1	N/A	100	WRS	N/A	N/A
Thallium	mg/L	134	NONPARAMETRIC	3	1	N/A	0	N/A	N/A	N/A
Tin	mg/L	133	NONPARAMETRIC	8	1	N/A	0	N/A	N/A	N/A
Uranium	mg/L	N/A	N/A	N/A	1	N/A	0	N/A	N/A	N/A
Vanadium	mg/L	139	NONPARAMETRIC	9	1	N/A	0	N/A	N/A	N/A
Zinc	mg/L	138	NONPARAMETRIC	57	1	N/A	100	WRS	N/A	N/A

Test: WRS = Wilcoxon Rank Sum, t-Test_N = Student's t-test using normal data, t-Test-LN = Student's t-test using log-transformed data, N/A = not applicable; site and/or background detection frequency less than 20%.
CRA Dataset ID: 062305_A1.

Table A6.3
Statistical Distribution and Comparison to Background for Surface Water, Total Analyses (excluding background samples) - 2000 - 2005 Data NN AEU

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test		
		Background			NN AEU (excluding background samples)			Test	1 - p	>Bkg
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Benzo(a)pyrene	ug/L	N/A	N/A	N/A	4	NONPARAMETRIC	0	N/A	N/A	N/A
bis(2-ethylhexyl)phthalate	ug/L	3	N/A	17	4	NORMAL	50	N/A	N/A	N/A
Di-n-butylphthalate	ug/L	1	N/A	6	4	NONPARAMETRIC	25	N/A	N/A	N/A
Pentachlorophenol	ug/L	N/A	N/A	N/A	4	NORMAL	0	N/A	N/A	N/A
Phenanthrene	ug/L	N/A	N/A	N/A	4	NORMAL	50	N/A	N/A	N/A
Phenol	ug/L	N/A	N/A	N/A	4	NORMAL	50	N/A	N/A	N/A
Pyrene	ug/L	N/A	N/A	N/A	4	NONPARAMETRIC	0	N/A	N/A	N/A
Aluminum	mg/L	166	NONPARAMETRIC	82	25	GAMMA	96	WRS	0.063	Yes
Ammonia	mg/L	1	N/A	0	1	N/A	100	N/A	N/A	N/A
Antimony	mg/L	169	NONPARAMETRIC	10	25	NONPARAMETRIC	28	N/A	N/A	N/A
Arsenic	mg/L	161	NONPARAMETRIC	23	25	NONPARAMETRIC	48	WRS	0.448	No
Barium	mg/L	172	NONPARAMETRIC	78	25	NONPARAMETRIC	100	WRS	0.000	Yes
Beryllium	mg/L	167	NONPARAMETRIC	13	25	LOGNORMAL	44	N/A	N/A	N/A
Cadmium	mg/L	165	NONPARAMETRIC	5	25	NONPARAMETRIC	12	N/A	N/A	N/A
Calcium	mg/L	172	NONPARAMETRIC	100	25	GAMMA	100	WRS	0.000	Yes
Chromium	mg/L	167	NONPARAMETRIC	29	25	LOGNORMAL	80	WRS	0.999	No
Cobalt	mg/L	171	NONPARAMETRIC	17	25	GAMMA	56	N/A	N/A	N/A
Copper	mg/L	164	NONPARAMETRIC	46	25	LOGNORMAL	92	WRS	1	No
Iron	mg/L	172	NONPARAMETRIC	97	25	LOGNORMAL	100	WRS	0.112	No
Lead	mg/L	166	NONPARAMETRIC	45	25	NONPARAMETRIC	56	WRS	0.957	No
Lithium	mg/L	166	NONPARAMETRIC	49	25	NONPARAMETRIC	100	WRS	0.00	Yes
Magnesium	mg/L	172	NONPARAMETRIC	86	25	GAMMA	100	WRS	0.000	Yes
Manganese	mg/L	171	LOGNORMAL	91	25	NONPARAMETRIC	100	WRS	8.77E-01	No
Mercury	mg/L	162	NONPARAMETRIC	11	22	NONPARAMETRIC	5	N/A	N/A	N/A
Molybdenum	mg/L	167	NONPARAMETRIC	22	25	GAMMA	84	WRS	1.000	No
Nickel	mg/L	167	NONPARAMETRIC	26	25	GAMMA	92	WRS	0.993	No
Potassium	mg/L	167	NONPARAMETRIC	74	25	NONPARAMETRIC	96	WRS	0	Yes
Selenium	mg/L	162	NONPARAMETRIC	14	25	NONPARAMETRIC	28	N/A	N/A	N/A
Silver	mg/L	170	NONPARAMETRIC	6	24	NONPARAMETRIC	8	N/A	N/A	N/A
Sodium	mg/L	172	NONPARAMETRIC	99	25	LOGNORMAL	100	WRS	0.006	Yes
Strontium	mg/L	168	NONPARAMETRIC	80	25	GAMMA	100	WRS	0.000	Yes
Thallium	mg/L	166	NONPARAMETRIC	6	25	NONPARAMETRIC	12	N/A	N/A	N/A
Tin	mg/L	161	NONPARAMETRIC	12	25	NONPARAMETRIC	4	N/A	N/A	N/A
Uranium	mg/L	9	GAMMA	22	25	NONPARAMETRIC	4	N/A	N/A	N/A
Vanadium	mg/L	171	NONPARAMETRIC	34	25	LOGNORMAL	88	WRS	7.67E-01	No
Zinc	mg/L	N/A	N/A	74	25	GAMMA	60	WRS	6.28E-01	No
Americium-241	pCi/L	101	NONPARAMETRIC	100	21	NONPARAMETRIC	100	WRS	0.931	No
Plutonium-239/240	pCi/L	107	NONPARAMETRIC	100	21	NONPARAMETRIC	100	WRS	0.374	No
Uranium-233/234	pCi/L	77	NONPARAMETRIC	100	21	NORMAL	100	WRS	3.33E-09	Yes
Uranium-235	pCi/L	74	NONPARAMETRIC	100	21	GAMMA	100	WRS	0.009	Yes
Uranium-238	pCi/L	77	NONPARAMETRIC	100	21	NORMAL	100	WRS	5.28E-09	Yes

Test: WRS = Wilcoxon Rank Sum, t-Test_N = Student's t-test using normal data, t-Test-LN = Student's t-test using log-transformed data, N/A = not applicable; site and/or background detection frequency less than 20%.
CRA Dataset ID: 062305_A1.

Table A6.4
Statistical Concentrations in Surface Water, Dissolved Analyses (including background samples) - 2000 - 2005 Data NN AEU

Analyte	Units	Total Samples	UCL Recommended by ProUCL	Distribution Recommended by ProUCL	Mean	Median	75th percentile	95th percentile	UCL[a]	UTL[b]	MDC[c]
Barium	mg/L	1	Too Few Observations To Calculate UCLs	0	0.640	0.640	0.640	0.640	N/A	N/A	0.640
Iron	mg/L	1	Too Few Observations To Calculate UCLs	0	46.0	46.0	46.0	46.0	N/A	N/A	46.0

[a] UCL = 95% upper confidence limit on the mean; [b] UTL = 95% upper confidence limit on the 90th percentile value, [c] MDC = maximum detected concentration.
CRA Dataset ID: 090105_A1.

Table A6.5
Statistical Concentrations in Surface Water, Total Analyses (including background samples) - 2000 - 2005 Data NN AEU

Analyte	Units	Total Samples	UCL Recommended by ProUCL	Distribution Recommended by ProUCL	Mean	Median	75th percentile	95th percentile	UCL[a]	UTL[b]	Maximum[c]
Phenanthrene	ug/L	2	Too Few Observations To Calculate UCLs	0	4.40	4.40	4.85	5.21	N/A	5.30	5.30
Total PAHs	ug/L	6	99% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	6.53	0.500	12.4	19.7	44.9	20.8	20.8
Aluminum	mg/L	24	95% Adjusted Gamma UCL	GAMMA	6.95	1.19	4.43	32.7	14.4	55.4	55.4
Ammonia	mg/L	1	Too Few Observations To Calculate UCLs	0	1.50	1.50	1.50	1.50	N/A	N/A	1.50
Barium	mg/L	24	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	0.187	0.140	0.193	0.385	0.327	0.820	0.820
Beryllium	mg/L	24	95% Chebyshev (MVUE) UCL	LOGNORMAL	3.25E-04	6.50E-05	2.25E-04	0.002	8.41E-04	0.002	0.003
Cadmium	mg/L	24	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	8.02E-05	5.00E-05	5.00E-05	2.44E-04	1.73E-04	5.20E-04	5.20E-04
Copper	mg/L	24	95% H-UCL	LOGNORMAL	0.007	0.004	0.006	0.026	0.011	0.026	0.044
Iron	mg/L	24	97.5% Chebyshev (MVUE) UCL	LOGNORMAL	8.21	1.03	4.83	40.4	37.3	57.2	76.0
Lead	mg/L	24	99% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	0.004	9.60E-04	0.002	0.022	0.021	0.034	0.034
Silver	mg/L	23	95% Student's-t UCL	NON-PARAMETRIC	1.32E-04	1.10E-04	1.18E-04	3.03E-04	1.68E-04	5.30E-04	5.30E-04
Vanadium	mg/L	24	95% Adjusted Gamma UCL	GAMMA	0.013	0.004	0.008	0.060	0.025	0.095	0.095
Zinc	mg/L	24	95% Approximate Gamma UCL	GAMMA	0.025	0.011	0.026	0.099	0.040	0.125	0.125

[a] UCL = 95% upper confidence limit on the mean; [b] UTL = 95% upper confidence limit on the 90th percentile value, [c] Maximum = maximum proxy result; may not be a detect.
CRA Dataset ID: 090105_A1.

Table A6.6
Summary of Surface Water in the MK AEU using Post-1999 ECOI Data

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Inorganic (Dissolved) (mg/L)										
Chromium	0	0	0	0	-	0	0	0	0	0
Manganese	0	0	0	0	-	0	0	0	0	0
Nickel	0	0	0	0	-	0	0	0	0	0
Uranium	0	0	0	0	-	0	0	0	0	0
Zinc	0	0	0	0	-	0	0	0	0	0
Inorganic (Total) (mg/L)										
Aluminum	2	2	100	0	-	0	0.0880	1.70	0.894	1.14
Barium	2	2	100	0	-	0	0.290	0.300	0.295	0.00707
Boron	2	2	100	0	-	0	0.0190	0.0200	0.0195	7.07E-04
Calcium	2	2	100	0	-	0	72	110	91	26.9
Cobalt	1	2	50	9.10E-04	-	9.10E-04	0.00230	0.00230	0.00138	0.00130
Iron	2	2	100	0	-	0	0.0870	2.80	1.44	1.92
Lithium	2	2	100	0	-	0	0.00530	0.00780	0.00655	0.00177
Magnesium	2	2	100	0	-	0	13	23	18	7.07
Potassium	2	2	100	0	-	0	2.50	4.10	3.30	1.13
Silica	2	2	100	0	-	0	13	17	15	2.83
Sodium	2	2	100	0	-	0	90	490	290	283
Strontium	2	2	100	0	-	0	0.440	0.590	0.515	0.106
Titanium	2	2	100	0	-	0	0.00270	0.0350	0.0189	0.0228
Vanadium	1	2	50	0.00240	-	0.00240	0.00350	0.00350	0.00235	0.00163
Radionuclide (Total) (pCi/L)										
Americium-241	2	2	100	0	-	0	0.00994	0.0230	0.0165	0.00923
Plutonium-239/240	2	2	100	0	-	0	-0.00922	0.217	0.104	0.160
Uranium-233/234	2	2	100	0	-	0	0.369	5.93	3.15	3.93
Uranium-235	2	2	100	0	-	0	-0.0271	0.117	0.0450	0.102
Uranium-238	2	2	100	0	-	0	0.194	3.39	1.79	2.26

[a] Values in this column represent reported results for U-qualified data (i.e., nondetects).

[b] For organics and inorganics, statistics are computed using one-half the reported result for nondetects.

[c] All radionuclide values are considered detects.

Table A6.7
Statistical Distribution and Comparison to Background for Surface Water, Total Analyses (excluding background samples) - 2000 - 2005 Data (MK AEU)

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test		
		Background			MK AEU (excluding background samples)			Test	1 - p	>Bkg
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Inorganics (mg/L)										
Aluminum	mg/L	166	NONPARAMETRIC	82	2	N/A	100	WRS	0.482	No
Antimony	mg/L	169	NONPARAMETRIC	10	2	N/A	0	N/A	N/A	N/A
Arsenic	mg/L	161	NONPARAMETRIC	23	2	N/A	0	N/A	N/A	N/A
Barium	mg/L	172	NONPARAMETRIC	78	2	N/A	100	WRS	0.011	No
Beryllium	mg/L	167	NONPARAMETRIC	13	2	N/A	0	N/A	N/A	N/A
Boron	mg/L	N/A	N/A	N/A	2	N/A	100	N/A	N/A	N/A
Cadmium	mg/L	165	NONPARAMETRIC	5	2	N/A	0	N/A	N/A	N/A
Calcium	mg/L	172	NONPARAMETRIC	100	2	N/A	100	WRS	0.008	No
Chromium	mg/L	167	NONPARAMETRIC	29	2	N/A	50	WRS	0.933	No
Cobalt	mg/L	171	NONPARAMETRIC	17	2	N/A	50	N/A	N/A	N/A
Copper	mg/L	164	NONPARAMETRIC	46	2	N/A	0	N/A	N/A	N/A
Iron	mg/L	172	NONPARAMETRIC	97	2	N/A	100	WRS	0.562	No
Lead	mg/L	166	NONPARAMETRIC	45	2	N/A	0	N/A	N/A	N/A
Lithium	mg/L	166	NONPARAMETRIC	49	2	N/A	100	WRS	0.271	No
Magnesium	mg/L	172	NONPARAMETRIC	86	2	N/A	100	WRS	0.008	No
Manganese	mg/L	171	LOGNORMAL	91	2	N/A	100	WRS	0.171	No
Mercury	mg/L	162	NONPARAMETRIC	11	2	N/A	0	N/A	N/A	N/A
Molybdenum	mg/L	167	NONPARAMETRIC	22	2	N/A	0	N/A	N/A	N/A
Nickel	mg/L	167	NONPARAMETRIC	26	2	N/A	100	WRS	0.892	No
Potassium	mg/L	167	NONPARAMETRIC	74	2	N/A	100	WRS	0.053	No
Selenium	mg/L	162	NONPARAMETRIC	14	2	N/A	0	N/A	N/A	N/A
Silica	mg/L	90	NONPARAMETRIC	98	2	N/A	100	WRS	0.018	No
Silver	mg/L	170	NONPARAMETRIC	6	2	N/A	0	N/A	N/A	N/A
Sodium	mg/L	172	NONPARAMETRIC	99	2	N/A	100	WRS	0.008	No
Strontium	mg/L	168	NONPARAMETRIC	80	2	N/A	100	WRS	0.024	No
Thallium	mg/L	166	NONPARAMETRIC	6	2	N/A	0	N/A	N/A	N/A
Tin	mg/L	161	NONPARAMETRIC	12	2	N/A	0	N/A	N/A	N/A
Titanium	mg/L	N/A	N/A	N/A	2	N/A	100	N/A	N/A	N/A
Uranium	mg/L	9	GAMMA	22	2	N/A	50	WRS	0.029	No
Vanadium	mg/L	171	NONPARAMETRIC	34	2	N/A	50	WRS	0.840	No
Zinc	mg/L	170	LOGNORMAL	74	2	N/A	50	WRS	0.452	No
Radionuclides (pCi/L)										
Americium-241	pCi/L	101	NONPARAMETRIC	100	2	N/A	100	WRS	0.027	No
Plutonium-239/240	pCi/L	107	NONPARAMETRIC	100	2	N/A	100	WRS	0.491	No
Uranium-233/234	pCi/L	77	NONPARAMETRIC	100	2	N/A	100	WRS	0.063	No
Uranium-235	pCi/L	74	NONPARAMETRIC	100	2	N/A	100	WRS	0.606	No
Uranium-238	pCi/L	77	NONPARAMETRIC	100	2	N/A	100	WRS	0.130	No

Test: WRS = Wilcoxon Rank Sum, t-Test_N = Student's t-test using normal data, t-Test-LN = Student's t-test using log-transformed data, N/A = not applicable; site and/or background detection frequency less than 20%.
CRA Dataset ID: 042705_D5.

Table A6.8
Statistical Concentrations in Surface Water, Total Analyses (including background samples) - 2000 - 2005 Data MK AEU

Analyte	Units	Total Samples	UCL Recommended by ProUCL	Distribution Recommended by ProUCL	Mean	Median	75th percentile	95th percentile	UCL[a]	UTL[b]	Maximum[c]
Aluminum	mg/L	2	Too Few Observations To Calculate UCLs	0	0.894	0.894	1.30	1.62	N/A	1.70	1.70
Iron	mg/L	2	Too Few Observations To Calculate UCLs	0	1.44	1.44	2.12	2.66	N/A	2.80	2.80
Zinc	mg/L	2	Too Few Observations To Calculate UCLs	0	0.161	0.161	0.241	0.304	N/A	0.320	0.320

[a] UCL = 95% upper confidence limit on the mean; [b] UTL = 95% upper confidence limit on the 90th percentile value, [c] Maximum = maximum proxy result; may not be a detect.
CRA Dataset ID: 090105_A1.

Table A6.9
Summary of Surface Sediment ECOI Data in the NN AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Inorganic (mg/kg)										
Aluminum	17	17	100		N/A		6,000	24,000	15,639	4,940
Arsenic	17	17	100		N/A		3.80	7.10	5.48	1.07
Barium	17	17	100		N/A		92.6	390	200	83.6
Beryllium	17	17	100		N/A		0.600	1.20	0.951	0.158
Boron	10	10	100		N/A		4.80	10	7.06	1.79
Cadmium	2	17	11.8	0.0560	-	1.20	0.110	0.160	0.224	0.223
Calcium	17	17	100		N/A		2,280	74,000	12,234	16,469
Cesium	1	5	20	98.3	-	120	3.90	3.90	42.6	22.1
Chromium	16	17	94.1	10	-	10	3.70	25	14.5	6.31
Cobalt	17	17	100		N/A		4.30	11.8	7.57	1.69
Copper	17	17	100		N/A		5.70	19.1	15.7	3.15
Iron	17	17	100		N/A		10,100	21,500	15,718	2,929
Lead	17	17	100		N/A		12	29.3	19.8	4.71
Lithium	15	15	100		N/A		4.30	15	9.83	2.83
Magnesium	17	17	100		N/A		1,200	4,200	3,034	810
Manganese	17	17	100		N/A		78	1,100	269	242
Mercury	10	17	58.8	0.0870	-	0.130	0.0170	0.0650	0.0495	0.0122
Molybdenum	11	15	73.3	1.40	-	2	0.260	5.20	0.939	1.20
Nickel	17	17	100		N/A		7	17	13.0	2.15
Nitrate / Nitrite	6	7	85.7	1.10	-	1.10	0.638	3.20	1.67	0.973
Potassium	17	17	100		N/A		989	2,810	1,729	569
Selenium	5	17	29.4	0.240	-	0.960	0.410	0.880	0.455	0.208
Silica	10	10	100		N/A		1,400	2,000	1,720	230
Silicon	5	5	100		N/A		153	417	263	107
Silver	1	17	5.88	0.0720	-	1.70	0.340	0.340	0.291	0.301
Sodium	15	17	88.2	41.1	-	100	38.1	600	158	135
Strontium	15	15	100		N/A		33.4	320	73.8	70.8
Thallium	9	17	52.9	0.330	-	0.480	0.310	2.30	0.481	0.530
Tin	4	15	26.7	1.80	-	47.5	7.70	10.7	4.98	6.53
Titanium	10	10	100		N/A		59	150	93.8	27.6
Vanadium	17	17	100		N/A		19.7	59	37.5	11.6
Zinc	17	17	100		N/A		29.1	110	64.2	18.6
Organic (ug/kg)										

Table A6.9
Summary of Surface Sediment ECOI Data in the NN AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
1,2,4-Trimethylbenzene	6	10	60.0	5.80	-	6.50	1.40	4.60	2.87	0.994
2-Butanone	1	15	6.67	10	-	31	13	13	10.6	3.51
Acetone	10	15	66.7	11	-	83	6.10	99	23.1	24.0
Anthracene	2	15	13.3	340	-	510	37	51	185	62.0
Benzo(a)anthracene	6	15	40	340	-	870	42	150	220	151
Benzo(a)pyrene	2	15	13.3	340	-	1,000	98	160	322	133
Benzo(b)fluoranthene	4	15	26.7	340	-	1,000	56	190	282	150
Benzo(g,h,i)perylene	2	15	13.3	340	-	1,000	71	89	316	143
Benzo(k)fluoranthene	1	15	6.67	340	-	1,000	110	110	340	125
bis(2-ethylhexyl)phthala	5	15	33.3	340	-	1,000	36	220	284	150
Chrysene	4	15	26.7	340	-	1,000	44	190	277	155
Di-n-butylphthalate	1	15	6.67	350	-	1,000	34	34	337	134
Fluoranthene	6	15	40	340	-	870	79	340	250	137
Indeno(1,2,3-cd)pyrene	2	15	13.3	340	-	1,000	57	86	315	145
Methylene Chloride	10	15	66.7	9	-	57	2.60	3.30	5.71	6.72
Naphthalene	3	15	20	5.80	-	500	1.70	2.50	66.9	95.4
Phenanthrene	6	15	40	340	-	870	57	280	238	143
Pyrene	2	15	13.3	340	-	1,000	210	320	340	113
Toluene	2	15	13.3	5	-	7.80	8	190	15.9	48.2
Total PAHs	7	15	46.7	1,000	-	5,883	1.90	1,952	4,254	1,203
Radionuclide (pCi/g)										
Americium-241	19	19	100	N/A			-0.0370	0.130	0.0287	0.0352
Cesium-134	3	3	100	N/A			0.0604	0.167	0.103	0.0569
Cesium-137	7	7	100	N/A			0.0640	1.21	0.327	0.403
Gross Alpha	7	7	100	N/A			4.82	37	19.8	11.3
Gross Beta	7	7	100	N/A			6.45	32	22.4	10.2
Plutonium-239/240	21	21	100	N/A			-0.0140	0.447	0.0443	0.0964
Radium-226	4	4	100	N/A			0.910	1.53	1.25	0.259
Radium-228	5	5	100	N/A			1.12	1.62	1.33	0.182
Strontium-89/90	7	7	100	N/A			0.0539	1.04	0.308	0.341
Uranium-233/234	19	19	100	N/A			0.480	1.51	0.952	0.226
Uranium-235	19	19	100	N/A			0	0.143	0.0642	0.0357
Uranium-238	19	19	100	N/A			0.500	1.58	0.968	0.234

Table A6.9
Summary of Surface Sediment ECOI Data in the NN AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation

[a] Values in this column represent reported results for U-qualified data (i.e., nondetects).

[b] For organics and inorganics, statistics are computed using one-half the reported result for nondetects.

[c] All radionuclide values are considered detects.

Table A6.10
Summary of Surface Sediment ECOI Data in the MK AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Inorganic (mg/kg)										
Aluminum	10	10	100	0	-	0	2,390	30,300	10,709	8,789
Antimony	1	10	10	0.540	-	14.1	12.4	12.4	3.59	3.91
Arsenic	10	10	100	0	-	0	1.40	8.40	3.37	2.32
Barium	10	10	100	0	-	0	18	145	73.6	48.0
Beryllium	8	10	80	0.260	-	0.540	0.260	1.50	0.541	0.416
Boron	2	2	100	0	-	0	1.40	4.20	2.80	1.98
Cadmium	3	10	30.0	0.260	-	1.46	0.0670	0.410	0.361	0.201
Calcium	10	10	100	0	-	0	470	30,000	5,138	8,873
Cesium	1	8	12.5	1.70	-	107	4.90	4.90	17.3	21.2
Chromium	10	10	100	0	-	0	2.10	44.3	12.3	13.1
Chromium VI	1	1	100	0	-	0	0.0130	0.0130	0.0130	0
Cobalt	9	10	90	8.20	-	8.20	1.90	9.30	4.89	2.24
Copper	9	10	90	4.70	-	4.70	3.10	33.2	12.7	10.7
Fluoride	1	1	100	0	-	0	8.47	8.47	8.47	0
Iron	10	10	100	0	-	0	4,200	27,500	12,303	7,906
Lead	10	10	100	0	-	0	2	73.6	16.7	21.5
Lithium	10	10	100	0	-	0	2.30	19.2	8.14	5.99
Magnesium	10	10	100	0	-	0	570	4,580	2,250	1,509
Manganese	10	10	100	0	-	0	67	326	181	86.6
Mercury	2	10	20	0.0600	-	0.243	0.0220	0.150	0.0654	0.0409
Molybdenum	5	10	50	1.20	-	7.28	0.320	2.40	1.43	1.07
Nickel	9	10	90	7.90	-	7.90	3.10	28.3	10.8	8.15
Nitrate / Nitrite	4	7	57.1	0.100	-	1.30	0.300	64	9.73	23.9
Potassium	10	10	100	0	-	0	423	2,940	1,387	924
Selenium	1	10	10	0.240	-	0.740	2.70	2.70	0.474	0.790
Silica	2	2	100	0	-	0	500	800	650	212
Silicon	3	3	100	0	-	0	252	854	463	339
Sodium	10	10	100	0	-	0	65.1	2,090	419	608
Strontium	10	10	100	0	-	0	4.10	44	22.3	14.4

Table A6.10
Summary of Surface Sediment ECOI Data in the MK AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Thallium	1	10	10	0.240	-	1.46	0.400	0.400	0.262	0.190
Tin	3	10	30.0	0.930	-	45.8	3.60	9.30	5.89	6.68
Titanium	2	2	100	0	-	0	66	110	88	31.1
Uranium	1	2	50	0.960	-	0.960	1.10	1.10	0.790	0.438
Vanadium	10	10	100	0	-	0	7.40	67.7	26.5	19.5
Zinc	10	10	100	0	-	0	19	347	91.6	103
Organic (ug/kg)					-					
2-Butanone	1	8	12.5	10	-	27	3	3	7.06	3.05
4-Methylphenol	1	8	12.5	340	-	1,200	95	95	303	173
Benzoic Acid	1	7	14.3	1,700	-	5,600	480	480	1,369	814
bis(2-ethylhexyl)phtha	3	8	37.5	390	-	1,200	52	120	315	232
Chrysene	1	8	12.5	340	-	1,200	150	150	310	164
Di-n-butylphthalate	3	8	37.5	390	-	1,200	38	280	289	197
Fluoranthene	2	8	25	340	-	1,200	88	170	291	180
Phenanthrene	1	8	12.5	340	-	1,200	96	96	303	172
Pyrene	2	8	25	340	-	1,200	61	170	288	184
Toluene	2	8	25	6	-	27	2	6	5	3.63
Total PAHs	2	8	25	2,720	-	9,600	149	586	5,327	2,476
Radionucides (pCi/g)					-					
Americium-241	10	10	100	0	-	0	-0.0242	0.0869	0.0174	0.0292
Cesium-134	3	3	100	0	-	0	0.0870	0.200	0.132	0.0597
Cesium-137	7	7	100	0	-	0	0.00200	0.391	0.154	0.133
Gross Alpha	9	9	100	0	-	0	-2.40	79	35.3	27.5
Gross Beta	9	9	100	0	-	0	8.45	69	44.1	16.9
Plutonium-239/240	10	10	100	0	-	0	0.00169	0.0538	0.0227	0.0176
Radium-226	5	5	100	0	-	0	0.390	1.90	0.918	0.597
Radium-228	3	3	100	0	-	0	0.930	1.70	1.19	0.442
Strontium-89/90	7	7	100	0	-	0	0.0300	0.316	0.178	0.113
Uranium-233/234	10	10	100	0	-	0	0.380	15	2.59	4.45
Uranium-235	10	10	100	0	-	0	0.0160	0.460	0.100	0.134

Table A6.10
Summary of Surface Sediment ECOI Data in the MK AEU

Analyte	Number of Detects	Number of Samples	Detection Frequency (%)	Range of Reported Detection Limits[a]			Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation
Uranium-238	10	10	100	0	-	0	0.310	13	2.30	3.86

Table A6.11
Summary of Adjacent Surface Soil Data in the NN AEU

Analyte	Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration (MDC)	Arithmetic Mean Concentration	Standard Deviation	ESL	MDC > ESL
Inorganics (mg/kg)								
Aluminum	**17**	**100%**	**6,420**	**18,000**	**10,467**	**3,156**	**15,900**	**Yes**
Barium	**17**	**100%**	**72.0**	**263**	**151**	**58.3**	**189**	**Yes**
Iron	17	100%	7,860	18,400	12,002	2,455	20,000	No
Lead	**17**	**100%**	**10.2**	**42.5**	**26.0**	**7.43**	**35.8**	**Yes**
Organics (µg/kg)								
Benzo(a)anthrancene	1	100%	84	84	84	N/A	108	No
Benzo(a)pyrene	1	100%	70	70	70	N/A	150	No
Benzo(g,h,i)perylene	1	0%	0	0	175	N/A	13	No
Chrysene	1	100%	81	81	81	N/A	166	No
Indeno(1,2,3-cd)pyrene	1	0%	0	0	175	N/A	17	No
Phenanthrene	1	100%	120	120	120	N/A	204	No
Pyrene	1	100%	160	160	160	N/A	195	No

Note: Includes soil data for all years.

Table A6.12
Summary of Adjacent Surface Soil Data in the MK AEU

Analyte	Number of Results	Detected	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration (MDC)	Arithmetic Mean Concentration	Standard Deviation	ESL	MDC > ESL
Inorganics (mg/kg)									
Aluminum	1	1	100%	9630	9,630	9,630	NA	15,900	No
Chromium	1	1	100%	11.1	11.1	11.1	NA	43.4	No
Fluoride	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nickel	1	1	100%	7.9	7.90	7.90	NA	22.7	No
Selenium	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Note: Includes soil data for all years.

Table A6.13
Total PAH Values for NN AEU Surface Water

Pond	Location Code	Sample Number	Collection Date	Record Count	Acenaph thene	Acenaph thylene	Anthracen e	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(g,h,i) perylene	Benzo(k) fluoranthene	Chrysene	Dibenz(a,h) anthracene	Fluoran thene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthale ne	Phenan threne	Pyrene	TOTAL RESULT
stLandfillPo	SWLF04	04D0879-013	6/16/2004	4	5.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.3	N/A	0.5	5.3	N/A	16.4
Channel	SW097	03D0099-001	10/30/2002	4	2.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.6	N/A	12	3.5	N/A	20.8
Channel	SW097	SW01617WC	10/9/1991	4	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3	N/A	22	5	N/A	33
Channel	SW097	SW70024ST	12/17/1992	4	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2	N/A	19	4	N/A	28
Channel	SW097	SW70026ST	1/25/1993	4	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2	N/A	14	4	N/A	23
Channel	SW097	SW70030ST	2/26/1993	4	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3	N/A	20	5	N/A	31
Channel	SW097	SW70046ST	3/24/1993	4	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3	N/A	25	6	N/A	38
Channel	SW098	97A2381-001	8/13/1997	4	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5	N/A	0.5	5	N/A	15.5
Channel	SW098	97A2568-001	9/8/1997	4	165	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	165	N/A	0.5	165	N/A	495.5
Channel	SW098	98D0128-005	10/15/1997	4	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5	N/A	0.5	5	N/A	15.5
Channel	SW098	98D0317-003	11/10/1997	4	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5	N/A	1.5	5	N/A	16.5
Channel	SW098	NP50686WC	9/9/1992	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.1	N/A	N/A	0.1
Channel	SW098	NP50724WC	12/11/1992	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.8	N/A	N/A	1.8
Channel	SW098	SW01620WC	10/16/1991	4	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5	N/A	5	5	N/A	20
Channel	SW098	SW70002ST	12/17/1992	4	4.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.5	N/A	4.5	4.5	N/A	18
Channel	SW098	SW70028ST	1/25/1993	4	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5	N/A	5	5	N/A	20
Channel	SW098	SW70036ST	2/26/1993	4	5.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.5	N/A	5.5	5.5	N/A	22
Channel	SW098	SW70043ST	3/24/1993	4	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5	N/A	5	5	N/A	20
Channel	SW098	SW70089JE	7/26/1993	4	2.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.5	N/A	0.5	2.5	N/A	8
Channel	SW098	SW70150JE	10/4/1993	4	2.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.5	N/A	0.5	2.5	N/A	8
Channel	SW098	SW70176JE	3/17/1994	4	2.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.5	N/A	0.5	2.5	N/A	8
Channel	SW098	SW70209JE	6/13/1994	4	2.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.5	N/A	0.5	2.5	N/A	8
Channel	SW098	VW00246JE	3/27/1993	4	2.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.5	N/A	2.5	2.5	N/A	10
Channel	SW099	01D0748-003	4/24/2001	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5	N/A	N/A	0.5
Channel	SW099	03D0722-001	4/2/2003	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5	N/A	N/A	0.5
Channel	SW099	99D4449-002	12/30/1998	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5	N/A	N/A	0.5
Channel	SW099	99D7115-001	4/29/1999	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5	N/A	N/A	0.5
Channel	SW099	SW01618WC	10/2/1991	4	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5	N/A	5	5	N/A	20
Channel	SW099	SW70049ST	3/24/1993	4	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5	N/A	5	5	N/A	20
Channel	SW100	01D0748-004	4/24/2001	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5	N/A	N/A	0.5
Channel	SW100	03D0722-002	4/2/2003	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5	N/A	N/A	0.5
Channel	SW100	99D7115-002	4/29/1999	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.5	N/A	N/A	0.5
Channel	SW10795	SW01001AS	7/3/1995	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25	N/A	N/A	0.25
Channel	SW10795	SW01002AS	7/3/1995	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25	N/A	N/A	0.25
Channel	SW10795	SW01016AS	7/3/1995	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16	N/A	N/A	16
Channel	SW10795	SW01017AS	7/3/1995	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25	N/A	N/A	0.25

Table A6.14
Total Detected PAH Values for NN AEU Surface Water

Pond	Location Code	Sample Number	Collection Date	Record Count	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	TOTAL RESULT
Channel	SW097	03D0099-001	10/30/2002	4	2.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.6	N/A	12	3.5	N/A	20.8
Channel	SW097	SW01617WC	10/9/1991	4	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3	N/A	22	5	N/A	33
Channel	SW097	SW70024ST	12/17/1992	4	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2	N/A	19	4	N/A	28
Channel	SW097	SW70026ST	1/25/1993	4	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2	N/A	14	4	N/A	23
Channel	SW097	SW70030ST	2/26/1993	4	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3	N/A	20	5	N/A	31
Channel	SW097	SW70046ST	3/24/1993	4	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3	N/A	25	6	N/A	38
Channel	SW098	98D0317-003	11/10/1997	1	ND	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	ND	N/A	1.5	ND	N/A	1.5
Channel	SW098	NP50724WC	12/11/1992	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.8	N/A	N/A	1.8
Channel	SW10795	SW01016AS	7/3/1995	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16	N/A	N/A	16

Table A6.15
Total PAH Values for NN AEU Sediment

Pond	Location Code	Sample Number	Collection Date	Record Count	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i) perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	TOTAL RESULT
stLandfillPo	CG57-000	05F0391-001	1/4/2005	12	N/A	N/A	220	61	440	440	440	440	49	N/A	90	N/A	440	2.50	76	440	3,139
stLandfillPo	CH57-000	05F0391-002	1/4/2005	12	N/A	N/A	255	54	500	500	500	500	500	N/A	87	N/A	500	1.70	66	500	3,964
stLandfillPo	CI57-000	05F0391-003	1/4/2005	12	N/A	N/A	200	400	400	400	400	400	400	N/A	400	N/A	400	1.90	400	400	4,202
stLandfillPo	CI57-001	05F0391-004	1/4/2005	12	N/A	N/A	195	390	390	390	390	390	390	N/A	390	N/A	390	2.95	390	390	4,098
stLandfillPo	CI58-000	05F0391-005	1/4/2005	12	N/A	N/A	200	405	405	405	405	405	405	N/A	405	N/A	405	3.05	405	405	4,253
stLandfillPo	CI58-001	05F0391-006	1/4/2005	12	N/A	N/A	220	435	435	435	435	435	435	N/A	435	N/A	435	3.30	435	435	4,573
stLandfillPo	CI58-002	05F0391-007	1/4/2005	12	N/A	N/A	190	42	380	64	380	380	44	N/A	85	N/A	380	2.90	61	380	2,389
stLandfillPo	CI58-003	05F0391-008	1/4/2005	12	N/A	N/A	210	420	420	420	420	420	420	N/A	420	N/A	420	3.20	420	420	4,413
stLandfillPo	CJ58-000	05F0391-009	1/4/2005	12	N/A	N/A	51	120	98	160	71	415	110	N/A	240	N/A	57	3.15	200	210	1,735
stLandfillPo	CJ58-001	05F0391-010	1/4/2005	12	N/A	N/A	215	46	430	56	430	430	430	N/A	79	N/A	430	3.25	57	430	3,036
Channel	SED006	6D00239WC	8/26/1991	12	N/A	N/A	175	175	175	175	175	175	175	N/A	175	N/A	175	175	175	175	2,100
Channel	SED006	6D00259WC	8/26/1991	12	N/A	N/A	170	170	170	170	170	170	170	N/A	170	N/A	170	170	170	170	2,040
Channel	SED006	6D00290WC	12/9/1991	12	N/A	N/A	37	150	160	190	89	110	190	N/A	340	N/A	86	200	280	320	2,152
Channel	SED006	6D00314WC	3/4/1992	12	N/A	N/A	250	250	250	250	250	250	250	N/A	250	N/A	250	250	250	250	3,000
Channel	SED036	6D00260WC	8/26/1991	12	N/A	N/A	180	180	180	180	180	180	180	N/A	180	N/A	180	180	180	180	2,160
Channel	SED68992	6D60089WC	5/7/1993	12	N/A	N/A	220	220	220	220	220	220	220	N/A	220	N/A	220	220	220	220	2,640

Table A6.16
Total Detected PAH Values for NN AEU Sediment

Pond	Location Code	Sample Number	Collection Date	Record Count	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	TOTAL RESULT
EastLandfil	CG57-000	05F0391-00	1/4/2005	5	N/A	N/A	ND	61	ND	ND	ND	ND	49	N/A	90	N/A	ND	2.5	76	ND	278.5
EastLandfil	CH57-000	05F0391-00	1/4/2005	4	N/A	N/A	ND	54	ND	ND	ND	ND	ND	N/A	87	N/A	ND	1.7	66	ND	208.7
EastLandfil	CI57-000	05F0391-00	1/4/2005	1	N/A	N/A	ND	ND	ND	ND	ND	ND	ND	N/A	ND	N/A	ND	1.9	ND	ND	1.9
EastLandfil	CI58-002	05F0391-00	1/4/2005	5	N/A	N/A	ND	42	ND	64	ND	ND	44	N/A	85	N/A	ND	ND	61	ND	296
EastLandfil	CJ58-000	05F0391-00	1/4/2005	10	N/A	N/A	51	120	98	160	71	ND	110	N/A	240	N/A	57	ND	200	210	1317
EastLandfil	CJ58-001	05F0391-01	1/4/2005	4	N/A	N/A	ND	46	ND	56	ND	ND	ND	N/A	79	N/A	ND	ND	57	ND	238
Channel	SED006	SD00290W	12/9/1991	11	N/A	N/A	37	150	160	190	89	110	190	N/A	340	N/A	86	ND	280	320	1952

COMPREHENSIVE RISK ASSESSMENT

ROCK CREEK AQUATIC EXPOSURE UNIT, MCKAY DITCH AQUATIC EXPOSURE UNIT, NO NAME GULCH AQUATIC EXPOSURE UNIT, SOUTH EAST DRAINAGE AQUATIC EXPOSURE UNIT

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Other Lines of Evidence in Support of the Risk Characterization

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ACRONYMS AND ABBREVIATIONS

μg/kg	microgram per kilogram
AEU	Aquatic Exposure Unit
bgs	below ground surface
BSF	biota to sediment factor
CRA	Comprehensive Risk Assessment
DOE	U.S. Department of Energy
ECOC	ecological chemical of concern
ECOPC	ecological contaminant of potential concern
EE	Environmental Evaluation
EEC	effective exposure concentration
EPC	exposure point concentration
ERA	Ecological Risk Assessment
HI	hazard index
HQ	hazard quotient
IA	Industrial Area
IBI	index of biotic integrity
IMP	Integrated Monitoring Plan
MK	McKay Ditch
N/A	not applicable
NN	No Name
NPDES	National Pollutant Discharge Elimination System
NW	North Walnut

OU	Operable Unit
PCB	polychlorinated biphenyl
PCOC	potential contaminant of concern
PMJM	Preble’s meadow jumping mouse
ppb	part per billion
RBP	Rapid Bioassessment Protocol
RC	Rock Creek
RFETS	Rocky Flats Environmental Technology Site
RFI/RI	Remedial Feasibility Investigation/Remedial Investigation
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
SE	Southeast
SW	Southwest
TSS	total suspended solids
WC	Woman Creek

1.0 INTRODUCTION

Previous research studies have been completed within the Rocky Flats Environmental Technology Site (RFETS) that help define the current ecological condition of the site. Many of these studies were focused within the Aquatic Exposure Units (AEUs). For the purposes of the Comprehensive Risk Assessment (CRA), a review of the studies that focused on ecological exposure, effects, and community characteristics within the AEUs was completed. Lines of evidence from one or more of these studies are provided as the linkages between exposure (i.e., chemical concentrations) and effects (i.e., observed responses from laboratory toxicity testing or field documented changes in populations or communities). These lines of evidence help to determine if chemicals are causing effects to the aquatic ecosystem within a given AEU.

The information available in these previous studies includes tissue analyses, aquatic population studies, bioassay analyses, waterfowl/wading bird studies, and chemical loading analyses. Only those portions of each study that fell within these categories were reviewed and relied upon. Information that was not used includes hazard quotient (HQ) analyses, wildlife studies, vegetation studies, and studies not focused upon the AEU areas. The types of line of evidence studies available from the reviewed literature are summarized in Table A7.1.

Only studies completed since 1991 were reviewed. These studies, in essence, captured a moment in time that was encompassed by the CRA AEU comprehensive databases. Therefore, the results have a direct application to the CRA because they co-occur in time and location.

Several studies provided multiple lines of evidence. For instance, the U.S. Department of Energy (DOE) (1996) evaluation was a baseline Ecological Risk Assessment (ERA) of Operable Units (OUs) 5 and 6 (Woman Creek and Walnut Creek) using a multi-tiered approach. This study included tissue analyses, bioassay analyses, and food chain modeling for waterfowl species, thereby providing three different lines of evidence for the CRA.

Studies with common goals were combined into a single subsection (i.e., aquatic ecological characterization studies, tissue analyses, etc.). The types of studies reviewed fall into a general set of lines of evidence categories that have ecological endpoints (i.e., impacts to populations of aquatic species), with one exception. Studies that describe chemical loading within a watershed were also reviewed as a line of evidence for surface water and/or sediment ecological contaminants of potential concern (ECOPCs) requiring further spatial extent analysis. These loading studies were not designed to address an ecological endpoint, but rather serve to define a chemical behavior within a watershed system. The categories of studies that were compiled are described below.

1.1 Tissue Analyses

The measure of chemical body burden in an aquatic receptor is a direct measure of bioaccumulation processes. Bioaccumulation refers to the degree to which an organism takes up and retains a contaminant from all applicable exposure routes. Bioaccumulation of a contaminant is typically expressed in terms of a bioaccumulation factor (BAF) which is the tissue concentration divided by the chemical concentration in the surrounding media. These measures are useful in determining whether a given surface water or sediment ECOPC is bioavailable and, thus, potentially harmful. Studies reviewed and used for their tissue analysis evaluations included the following:

- Stiger, 1994a. OU 3 Final RFI/RI – Appendix K. PCB Study: "Results of PCB Sediment and Tissue Sampling For Walnut and Woman Creek Drainages and Offsite Reservoirs – SGS-576-94."

- DOE, 1996. Final Phase I RFI/RI Report. Woman Creek Priority Drainage, Operable Unit 5. Appendix N. Ecological Risk Assessment for Woman Creek and Walnut Creek Watersheds at the Rocky Flats Environmental Technology Site.

1.2 Aquatic Population Studies

The composition of aquatic communities represents the sum of multiple physical, biological and chemical influencing factors. Sessile organisms such as benthic macroinvertebrates can be highly susceptible to habitat disturbance, including chemical releases. The measure of species and population indicators (biometrics) such as species richness, density, diversity, etc., is often a useful tool to determine chemical effects so long as a habitat reference condition is understood. Biometrics are influenced by chemical, physical, and biological factors, all of which need to be understood in order to isolate a single factor's effect on a given population. Numerous biological inventory studies have been completed within RFETS. A number of these were designed to define the aquatic health condition within a potentially affected watershed component (e.g., Woman Creek) as compared to a background or reference watershed component (e.g., Rock Creek). The endpoint of most of these studies was to determine the causative factor controlling the ecology, whether physical (habitat), biological (species inter- or intra-actions), or chemical (RFETS chemical release). Many of these studies evaluated both biological and abiotic (physical and chemical) features of a watershed within RFETS at once. Some were focused on particular segments, or streams for a defined purpose (for example, ammonia spatial extent within Big Dry Creek). Aquatic population studies reviewed and integrated into the CRA included the following:

- Aquatics Associates Inc., 1998. Interim Report: Results of the Aquatic Monitoring Program in Big Dry Creek, 1997. Prepared for Cities of Broomfield, Northglenn and Westminster, Colorado.

- Aquatics Associates Inc., 2003. Results of the Aquatic Monitoring Program in Streams at the Rocky Flats Site, Golden, Colorado 2001-2002. Prepared for U.S. Department of Energy, Rocky Flats Field Office Golden, Colorado.

- Ebasco Environmental Consultants Inc., 1992. Baseline Biological Characterization of the Terrestrial and Aquatic Habitats at Rocky Flats Plant. Prepared for U.S. DOE, Rocky Flats Field Office. Golden, Colorado.

- Exponent, 1998. Final Report: Lower Walnut Creek Aquatic Sampling, Spring 1998. Prepared for Kaiser-Hill Company, LLC, Rocky Flats Environmental Technology Site. Golden, Colorado.

- Wright Water Engineers, Inc. 2003. Supplemental Biological and Selected Water Quality Data Exploration 1997-2001. Provided to Big Dry Creek Watershed Association Steering Committee. April 8, 2003.

- DOE, 1996. Final Phase I RFI/RI Report. Woman Creek Priority Drainage, Operable Unit 5. Appendix N. Ecological Risk Assessment for Woman Creek and Walnut Creek Watersheds at the Rocky Flats Environmental Technology Site.

- Kaiser-Hill, 1999. 1998 Annual Wildlife Survey for the Rocky Flats Environmental Technology Site. Kaiser-Hill Company, L.L.C., Rocky Flats Environmental Technology Site, Golden, Colorado. (three reports).

- Kaiser-Hill, 2000. 1999 Annual Wildlife Survey for the Rocky Flats Environmental Technology Site. Kaiser-Hill Company, L.L.C., Rocky Flats Environmental Technology Site, Golden, Colorado.

- Kaiser-Hill, 2001. 2000 Annual Wildlife Survey for the Rocky Flats Environmental Technology Site. Kaiser-Hill Company, L.L.C., Rocky Flats Environmental Technology Site, Golden, Colorado.

1.3 Bioassay Analyses

Bioassays test the toxicity attributable to potentially contaminated media and provide a direct measure of chemical risk. Two studies completed bioassay analyses:

- DOE, 1996. Final Phase I RFI/RI Report. Woman Creek Priority Drainage, Operable Unit 5. Appendix N. Ecological Risk Assessment for Woman Creek and Walnut Creek Watersheds at the Rocky Flats Environmental Technology Site.

- Wolaver et al. 1993. Toxicity Monitoring in Rocky Flats Plant Surface Waters May 1991 – June 1992. Rocky Flats Plant, Environmental Protection Management, Surface Water Division.

1.4 Waterfowl/Wading Bird Studies

Waterfowl, wading birds, and higher trophic organisms were not identified as target receptors for the AEU CRA. However, the CRA methodology (DOE 2004a) suggests that studies of these organisms may be useful lines of evidence within the CRA. For that purpose, these studies were evaluated in this attachment:

- DOE, 1996. Final Phase I RFI/RI Report. Woman Creek Priority Drainage, Operable Unit 5. Appendix N. Ecological Risk Assessment for Woman Creek and Walnut Creek Watersheds at the Rocky Flats Environmental Technology Site.

- Stiger, 1994a. OU 3 Final RFI/RI – Appendix K. PCB Study: "Results of PCB Sediment and Tissue Sampling For Walnut and Woman Creek Drainages and Offsite Reservoirs – SGS-576-94."

1.5 Chemical Loading Analyses

The spatial extent of a particular surface water and/or sediment ECOPC can be determined with a synoptic sampling that follows the course of a "slug" of water as it travels through a drainage. Measures of chemical concentration are synchronized with flow in order to determine load. Load is then compared from location to location as the slug of water progresses downgradient. Where a dramatic increase in load is observed, a potential source area may be the cause. Loading analyses therefore help describe the spatial distribution of a chemical and determine if it is gaining in concentration, losing in concentration, typical of the drainage, or potentially related to source areas. The following study describes such efforts and was used as a line of evidence for the CRA:

- DOE, 2004b. Rocky Flats Environmental Technology Site Automated Surface-Water Monitoring. Water Year 2003 Annual Report and Water Year 2004 Source Evaluations for Points of Evaluation GS10, SW027, and SW093. RF/EMM/WP-04-SWMANLRPT03.UN. Final.

2.0 TISSUE ANALYSES

2.1 Stiger, 1994a

OU 3 Final RFI/RI – Appendix K. PCB Study: "Results of PCB Sediment and Tissue Sampling For Walnut and Woman Creek Drainages and Offsite Reservoirs – SGS-576-94."

Review

This study was completed in response to preliminary results of sediment and tissue samples collected during the OU 6 Remedial Investigation (RI) between August 1992 and June 1993, which indicated elevated polychlorinated biphenyl (PCB) concentrations occur for some of the A- and B-series ponds. Because the potential exists for sediment and/or specific biota in Great Western Reservoir and Standley Lake Reservoir to have been affected by PCB contaminants from RFETS prior to 1989 (prior to the diversion canal being constructed that routes flow coming from Walnut Creek around Great Western Reservoir and back into Walnut Creek below the dam), a sediment and tissue PCB sampling project was undertaken as part of the Environmental Evaluation (EE) portion of the OU 6 RI.

The effort entailed sampling of sediment and biota tissue from the A- and B-series ponds. Fish samples also were collected from the Walnut Creek terminal pond at Indiana Street (OU 6) and Great Western Reservoir to determine if any PCBs had migrated downstream of the terminal ponds, Mower Reservoir, Standley Lake Reservoir, and the C- and D-series ponds.

An attempt was made to collect three of each species of fish for whole body analysis. When additional numbers of the same species were sacrificed, they were used for filet or liver analysis. Results were compared to literature-derived values to determine potential effects. The following values were used to compare tissue results:

- Reproductive impairment in rainbow trout may occur at concentrations above 400 micrograms per kilogram (μg/kg) fresh weight (EPA 1980, as reported in Eisler 1986).
- The recommended maximum body burden for trout is 400 μg/kg fresh weight (Eisler 1986).
- A reported value of 5,000 μg/kg is protective of human health consumption (Hoeting 1983, as reported in Eisler 1986).
- An observed typical body burden concentration for fish is 1,000 μg/kg (Schnitt, et al. 1983, as reported in Eisler 1986).
- Food concentration thresholds recommended by DOE (1994) for fish-eating birds are 667 parts per billion (ppb) for the belted kingfisher and 768 ppb for the great blue heron.

In addition, a sampling effort was undertaken to evaluate whether the Preble's meadow jumping mouse (PMJM) might be impacted by the presence of PCBs in the RFETS buffer zone. Because the PMJM has a diet similar to deer mice, 13 deer mice were collected adjacent to Ponds A-1, A-3, B-1, and B-4 for whole body tissue analysis to evaluate possible PCB contamination in PMJM. In addition, 12 voles were collected from the same locations to determine if they represent a pathway of PCBs to predatory birds, which include voles in their diet.

Results from the sediment sampling program (collected at depths of 0 to 6 inches below ground surface [bgs]) in both the A- and B-series ponds show a decreasing concentration of PCBs, primarily Aroclor-1254, with distance downstream. The mean values of

Aroclor-1254 and Aroclor-1248 in the A, B, and C ponds are summarized in Table A7.2. Conclusions drawn from the sediment analysis are as follows:

- Sediments collected from Pond B-2 have a considerably higher mean Aroclor-1254 concentration than those collected from either Pond B-1 or B-3. It was speculated that this was due to the presence of an outfall that historically discharged into Pond B-2.

- Ponds B-1 and B-2 contain the only sediment sampling locations where Aroclor-1248 was detected.

- No PCBs were detected in terminal Ponds A-4 or B-5.

- No PCBs were detected in sediment collected from the C-1 and C-2 ponds.

PCB concentrations in both the A- and B-series ponds decrease with distance downstream to the point where no PCBs were detected in terminal Ponds A-4 or B-5. In addition, no PCBs were detected in sediment samples collected from Ponds C-1 and C-2. These results suggested that it was highly unlikely that RFETS contributed PCBs to offsite reservoirs.

In the A and B ponds, four types of whole body tissues were analyzed: largemouth bass (40-58 μg/kg), fathead minnows (14-479 μg/kg), tiger salamanders (26 – 134 μg/kg), and crayfish (BDL – 9.5 μg/kg).

Concentrations of Aroclor-1254 in crayfish samples collected from Ponds A-2, A-3, and A-4 were less than detection. Tissue samples collected from Pond A-1 were not large enough to support chemical analyses. Benthic tissues collected from Pond A-2 averaged 20 ug/kg while LMB tissue averaged 48 ug/kg. Pond A-3 samples only included crayfish. Pond A-4 included fathead minnows that averaged 17 ug/kg. Largemouth bass in Pond A-2 had a BSF of 0.6. The sediments within the upper 15 cm had generally lower PCB concentrations than the deeper sediments, suggesting a lower risk to aquatic life than indicated by the earlier data. The ponds with the highest tissue concentrations of PCBs were not the ponds with the highest sediment PCB concentrations.

Concentrations of Aroclor-1254 in tissue samples from the B-Series Ponds include data from Tiger Salamanders, fathead minnows, and crayfish. Tiger Salamander tissues from Pond B-1 averaged 33 ug/kg (n=2), while in Pond B-2 salamander tissues averaged 99.3 ug/kg (n=3). No tissue data from aquatic organisms were collected from Pond B-3. Fathead minnow tissues from Pond B-4 averaged 480.3 (n=3) while in Pond B-5, fathead minnow tissues residues averaged 159.3 (n=3) and crayfish tissues were generally less than detection (15 ug/kg).

Concentrations of Aroclor-1254 in tissue samples from the C-Series Ponds include data for crayfish, Bluegill sunfish and a single chub. Crayfish samples (n=3) were all less than detectable (15 ug/kg). Bluegill (n=2) tissues ranged from 36 to 69 (ug/kg) while the single chub tissue sample was 100 ug/kg.

Summary conclusions are as follows:

- For the A-series ponds, no consistent trends could be observed. Species were either present and collected in one pond only or the PCB concentrations were below detection limits.

- For the B-series ponds, the PCB concentrations increased in tiger salamanders from the B-1 to B-2 ponds with no further specimens being found downstream, and decreased in fathead minnows from B-4 to B-5. PCBs were detected in fathead minnows collected from the Walnut Creek terminal pond at Indiana Street in even lower concentrations than in Pond B-5.

- Only one fish species was collected from Great Western Reservoir. Of the six carp specimens collected, only one contained detected quantities of PCBs (52.4 µg/kg).

- Fish tissue samples collected from Ponds C-1 and C-2 contained only low levels of PCBs (<100 µg/kg), and no PCBs were detected in fish tissues collected from Ponds D-1 and D-2 or Mower reservoir.

- The highest concentration of PCBs found in any animal tissue during this study was in a carp (1,000 µg/kg) collected from Standley Lake Reservoir. Historically, less than 5 percent of the water flowing into Standley Lake Reservoir has come from RFETS. In addition, all of the Woman Creek drainage above the divide on Woman Creek below the C-2 dam has been diverted to Mower Reservoir since 1989, and currently no surface water enters this reservoir. Therefore, it is highly unlikely that the PCBs found in the fish tissue samples collected from Standley Lake were derived from RFETS.

- The only tissue samples collected on RFETS to exceed Eisler's (1986) recommended maximum body burden for trout (400 µg/kg fresh weight) were three fathead minnow specimens (464 – 498 µg/kg for whole body) collected from the B-4 pond.

Data from this study are subsequently used in DOE 1996 to assess risks to aquatic organisms and birds due to bioaccumulation (see Section 2.2).

Application to the CRA and Uncertainties

This study incorporated several lines of evidence within its design. The A-, B-, and C-series ponds were sampled specifically to assess PCB transfer between abiotic (sediment) and biotic (fish tissue) media. The absence of PCB accumulation in excess of tissue threshold concentrations in almost all fish collected from RFETS ponds indicates there is a low potential for risk to fish in the pond habitat within NW AEU, SW AEU, WC AEU, and SE AEU. Results of sediment samples did not yield any detectable levels of PCBs in terminal Ponds A-4 and B-5 which suggested that PCBs were not migrating to offsite reservoirs.

The only tissue samples collected on RFETS to exceed Eisler's (1986) body burden for trout (400 μg/kg flesh weight) were three fathead minnow specimens collected from the B-4 pond that had an average Aroclor-1254 content of 498 μg/kg. The time period in which this study was completed represents an historic condition for RFETS. A significant number of accelerated action efforts have been completed since this time. The sediments from certain ponds (B-1, B-2, and B-3) have been removed, and the food web components that were initially sampled from each pond may no longer be present. Therefore, the study likely represents conservative conditions and over-estimates PCB risks when compared to current conditions at RFETS.

2.2 DOE, 1996

Final Phase I RFI/RI Report. Woman Creek Priority Drainage, Operable Unit 5. Appendix N. Ecological Risk Assessment for Woman Creek and Walnut Creek Watersheds at the Rocky Flats Environmental Technology Site.

Review

The ERA for OUs 5 and 6 used a multi-tiered approach to evaluate risks to aquatic and terrestrial receptors. The first tier represented a conservative screening approach that served to recommend additional steps of refinement for more baseline-level ERA evaluations. One additional step was the evaluation of PCBs, which initially indicated negligible risk to aquatic-feeding birds (as per the screening-level findings). However, DOE (1996) recommended further analysis because 1) data on biological tissues were not available for all ponds in which PCBs were detected in sediments, and 2) development of the aquatic community in ponds could result in increased biological transport of sediment contaminants and increased exposure to aquatic-feeding birds.

During the Remedial Feasibility Investigation/Remedial Investigation (/RFI/RI) field sampling at OU 6, sediments were collected from multiple locations within each of the A- and B-series ponds and analyzed for several PCB congeners. Only Aroclor-1254 and Aroclor-1260 were detected in these samples, and concentrations varied considerably between ponds. The highest concentrations were in the most upstream ponds in each watershed, with progressively lower concentrations down-gradient. In general, concentrations in sediments from the B-series ponds averaged ten times those in the A-series ponds, reflecting the fact that the South Walnut Creek watershed includes most of the industrialized area of RFETS and receives discharge from the wastewater treatment plant. PCBs were detected in 100 percent of the samples from Ponds A-1, B-1, B-2, B-3, and B-4; in three of four samples from Pond A-2; and in none of the samples from Ponds A-3, A-4, and B-5. These data were generated from samples collected from the surface as well as at depth. Aquatic organisms typically are not exposed to sediments below the upper 15 cm. Data generated during the RFI/RI field program, which included collection of sediment samples below this depth, did not permit evaluation of biological exposures. Consequently, sediments and biota in the ponds were re-sampled and re-analyzed to obtain data more appropriate for assessing ecological risk. Samples were taken from the upper 15 cm of sediment at the same sites sampled during the earlier investigation. Where available, tissue samples also were collected for fish, salamanders, crayfish, and benthic macroinvertebrates. Sampling was conducted in June and July 1994. A preliminary report on the results of this follow-up sampling and analysis was submitted to DOE by EG&G (Stiger, 1994a; see Section 2.1 above). DOE (1996) used the data collected in 1994 to assess potential risks to predatory birds exposed to PCBs. This exposure and analysis discussed in this section were based on results of the 1994 sampling.

DOE (1996) calculated the ratio of Aroclor-1254 content in biota to that in sediments for ponds in which Aroclor-1254 was detected in both sediments and biological samples (Table A7.4). The variability of biota types available and the lack of PCB detections in some ponds with biota, limited comparison of biota-to-sediment factor (BSF) values among ponds. BSF ratios varied among biota types, ranging from 0.1 in salamander neonates from Pond B-1 to 3.3 in fathead minnows from Pond B-4. Largemouth bass, which were found only in Pond A-2, had a BSF of 0.6. These values were comparable to BSFs estimated for aquatic biota in other studies (Rassmussen, et al. 1990; Macdonald, et al. 1993).

Application to the CRA and Uncertainties

This study provided several lines of evidence within its design. A-, B-, and C-series ponds were sampled specifically to assess PCB transfer between abiotic (sediment) and biotic (fish tissue) media. The generally low BSF ratios suggests a low risk to higher trophic organisms, as well as the receptors directly exposed to pond sediments. The measured tissue concentrations in specimens collected from Pond B-4 are just above tissue thresholds protective of fish (Stiger 1994b). This moderate level of bioaccumulation indicates a possible risk from PCBs.

The time period in which this study was completed represents an historic condition for RFETS. A significant number of accelerated action efforts have been completed since this time. The sediments from certain ponds (B-1, B-2, and B-3) have been removed, and the food web components that were initially sampled from each pond may no longer be present. Therefore, the results of this study are not directly applicable to the current conditions represented in the CRA.

3.0 AQUATIC POPULATION STUDIES

3.1 Ebasco Environmental Consultants Inc., 1992

Baseline Biological Characterization of the Terrestrial and Aquatic Habitats at Rocky Flats Plant.

Review

This study provided an inventory and cursory assessment of the ecological health of the aquatic habitats within the RFETS buffer zone. A variety of methods were used to collect and observe aquatic species. Fish sampling employed gill nets, minnow traps, and limited electro-shock sampling. Benthic macroinvertebrate sampling used grab sampling techniques to collect field samples. These samples were returned to the laboratory for taxonomic identification and quantification of benthic samples. Algal and periphyton samples were also collected. Samples were collected during the Spring and Fall seasons in 1991 during May-June and again in August-September. A-, B-, C-, and D- Series ponds were sampled. Stream samples were collected on Woman Creek, Rock Creek, and Walnut Creek downstream of the North and South Walnut Creek confluence.

The occurrence of taxa within the benthic communities of streams and ponds was assessed, and generalizations about aquatic community health were made based on the presence or absence of various taxon, including those that may indicate tolerance or intolerance to pollutants (Table A7.5).

The aquatic habitats were found to have high species richness, an indication of a healthy ecosystem. The report documents that aquatic habitats at RFETS have a high density of benthic macroinvertebrates. Fish species diversity is naturally low in the semiarid climate characterized by intermittent streams and small pools and ponds that are inadequate to support large fish populations. Nine species of fish were collected at RFETS, most in the minnow family Cyprinidae (six species). Most species were found in pools or impoundments that offer refuge from annual drought conditions. Several ponds had very high populations of golden shiners and fathead minnows.

The authors report that the most disruptive environmental factor to aquatic communities at RFETS is the naturally semiarid climate. All streams have sections that are intermittent, while the perennial sections are fed by groundwater seeps. Aquatic communities on RFETS thrive despite the environmental limitations. Many aquatic organisms present are adapted to low stream flow conditions. These organisms are often classified as “tolerant” considering general water quality.

Benthic macroinvertebrate samples from Walnut Creek contained 59 taxa during fall sampling. Diptera had the highest species richness with 24 species. One species of fish, fathead minnows, was collected from the B-series ponds. Two species of fish were collected from the A-series ponds, fathead minnow and golden shiner. No predatory fish were found.

The East Landfill Pond supports no fish and only a depauperate benthic macroinvertebrate community. Macrobenthic sampling documented eight taxa of macrobenthic organisms present in the pond, including organisms in the groups Gastropoda, Pelecypoda, Oligochaeta, Hydracarina, Amphipoda, and Diptera.

In Woman Creek, the benthic macroinvertebrate community was relatively rich and diverse. The most abundant and widespread groups in the stream communities were the larvae of true flies (Diptera) and mayflies (Ephemoptera). The most common dipteran taxa are blackflies (Simulidae) and midges (Chironomidae). Both caenid and baetid mayflies also are common. Species richness for mayflies and caddisflies increased from headwater segments to the area east of Pond C-2, where flow in Woman Creek decreases (apparently due to loss to groundwater). Communities within the ponds are strongly dominated by midges and aquatic earthworms (Oligochaeta). Pond C-1 had a more developed aquatic plant community along the edge, supporting a more diverse assemblage of nektonic forms, including water striders (Hemiptera: Gerridae) and water boatmen (Hemiptera: Corixidae). Predatory dragonfly nymphs (Odonota) were present in the C ponds, as were crayfish (Astacidae).

Fish species within the streams of Woman Creek included the creek chub, stoneroller, fathead minnow, and green sunfish. Fish communities in the C ponds are influenced by the presence of suitable substrates, vegetation, and persistent water. The most common species included the golden shiner, white sucker, and largemouth bass found in Pond C-1; however, creek chubs and stonerollers were observed frequently throughout the upper sections of Woman Creek. Golden shiners feed on a variety of small prey and algae and may themselves be important prey for larger fish or piscivorous birds because of the large populations they attain and their relatively large size. Aquatic vertebrates in Pond C-2 comprise fathead minnows and the aquatic form of tiger salamanders (Ambystoma tigrinum).

Comparisons of the watersheds were conducted. Findings indicate that seasonal fluctuations in availability of surface water would affect populations and species in each watershed. Water quality did not show great differences between the three watersheds, but did vary between pond and stream habitats. Of note, high concentrations nutrients were present in the fall. Of the watersheds evaluated, the Woman Creek watershed had the highest diversity of phytoplankton, periphyton, benthic macroinvertebrates, and fish. This was attributed to the greater diversity of habitats available in Woman Creek. Walnut Creek had similar diversity of the different communities evaluated to Rock Creek.

Application to the CRA and Uncertainties

This study documented the baseline conditions of aquatic organisms present at RFETS in 1991. The results of the population studies provide line of evidence for NW AEU, SW AUE, WC AEU, and NN AEU in regard to populations and overall ecosystem health.. The species composition is a reflection of the habitat condition; physical stressors such as fluctuating flow were a primary factor in determining the composition of the aquatic communities. There does not appear to be any chemical stressor affecting the populations sampled from the ponds or stream channels.

The time period in which this study was completed represents an historic condition associated with RFETS. A significant number of accelerated action efforts have been completed since this time period. The food web components that were initially sampled from certain ponds may no longer be present, and the flows of water into and out of some ponds have been altered. For instance, Pond C-1 was modified to have a lower depth, the B-series ponds receive less water, and the upper B ponds have been remediated by having sediments removed. Therefore, current conditions are likely different from those described in this study.

3.2 DOE, 1996

Final Phase I RFI/RI Report. Woman Creek Priority Drainage, Operable Unit 5. Appendix N. Ecological Risk Assessment for Woman Creek and Walnut Creek Watersheds at the Rocky Flats Environmental Technology Site.

Review

This study was completed as a part of the ecological risk evaluation of aquatic life for OUs 5 and 6. The risk assessment used a Triad approach where chemistry, biology, and toxicity were all evaluated to assess potential risks. Using literature based effects values, hazard quotients (HQs) and hazard indices (HIs) were generated as a screening tool and indicated a relatively high potential for toxic effects in sediments.

It appears that the data used to assess the aquatic community dynamics in DOE (1996) are from the DOE (1993) and DOE (1995) Ecological Monitoring Program Annual Reports. Benthos samples were collected from all of the A-(North Walnut AEU), B-(South Walnut AEU), C-(Woman Ck AEU), and D-series (Southeast AEU) ponds during May through July 1994. Pond A-5 also known as Flume Pond is downstream of the confluence of North and South Walnut Creeks. Benthic communities for Ponds D-1 and D-2 were sampled to represent locations with no known contaminant input from RFETS. Five replicate multi-core composite samples were obtained from various submerged habitat types to ensure complete representation of the pond biota. Samples were analyzed for taxonomic composition and abundance. Taxa identifications were made to the lowest practical taxonomic level.

Descriptive data for community parameters such as richness, density, Simpson and Shannon-Weiner diversity measures, number of dominant taxa (Hill’s N1) (Ludwig and Reynolds 1988), and abundance-based relationships for oligochaetes and dipterans were derived. The data represent a composite of data from the different pond habitat sampled. Conventional interpretation of the benthic community structure suggests that communities with low densities of organisms or reduced richness and diversity are subject to physical or chemical stress. Benthic communities with high densities of pollution tolerant species may be indicative of stress.

Pollution tolerance values were used to evaluate benthic community health and responses to pollution stress. A tolerance value of 0 equates to no pollution tolerance while a value of 10 equates to highly tolerant organisms.

A total of 81 different taxa representing all the major orders of benthic organisms were identified in the pond samples. A listing of identified taxa and mean abundance for each pond was compiled. Community description measures generated for each pond are summarized in Table A7.6. Oligochaete worms and dipterans dominated the benthos samples from all locations. General conclusions drawn from the study include the following:

- The B-series ponds contained the highest abundance of all taxa except fingernail clams (pelecypoda) which were most abundant in the A-series ponds.
- The C-series ponds did not support a wide variety of organisms other than oligochaetes and dipterans.
- Pond B-4 had the highest organism abundance of all of the ponds evaluated and the lowest species richness and diversity indices of the ponds sampled during this study.
- Ponds A-1 and A-3 had the least pollution-tolerant communities of all ponds, including the D-series reference ponds. Ponds A-2 and B-2 had the most pollution-tolerant communities. Pollution tolerance values for the most commonly collected taxa from all ponds were relatively moderate (5) to high (10).
- Ponds D-1 and D-2 exhibited a wide range of community characteristics, including the second lowest (Pond D-1) and highest (Pond D-2) diversity values.
- Of the ponds affected by RFETS, the B-series ponds had organism densities (number/m^2) of Ephemeroptera, Odonates, Coleoptera, Crustacea, and Gastropods, that were much higher than A or C series ponds (where these types of organisms were largely absent). Densities of representatives of these orders in the B series of ponds were also higher than those in the D series of ponds.
- A cursory review of the benthic community data indicates that Ponds A-4, B-3, and C-1 may have been under the most persistent stress. In each of these ponds, oligochaetes and dipterans were the dominant taxa. These organisms are considered good colonizers and frequently are the dominant taxa from habitats with high physical variability. The highly variable environmental (physicochemical) conditions at RFETS may account for the dominance of colonizers.

The data were analyzed to identify sites with benthic communities that were similar in composition and structure to sites with no known exposure to contaminants (Ponds D-1 and D-2). However, although the sediments from Pond D-1 were considered to be uncontaminated, the low richness and diversity and the high abundance of a single taxon at this site appear to reflect some type of environmental stress.

Cluster analysis techniques were used to determine the relationship between the HI estimate and community structure for each pond. Results from the analysis indicate that none of the community structure parameters mirror the HI site patterns. This result suggests a lack of correlation between the magnitude of the HIs and pond benthic community structure. Further analysis involving regression methods were used to estimate whether the proportion of variation in community structure could be explained by differences in HIs. Results indicate that predicted toxicity appears to account for some of the variation in community composition, but other factors are clearly important. Factors such as pond size, fluctuating water levels, and the presence or absence of upper trophic levels are also strongly correlated with community composition. Applications to the CRA and Uncertainties

This study evaluated benthos samples collected from all of the A-, B-, C- and D-series ponds during May through July 1994.The results represent a snapshot in time of the aquatic ecology within the time-frame of the data collected for the CRA analysis. Results indicate that the pond populations at the time of the study were comparable to reference conditions. In addition, there was little correlation of population biometrics to chemical indices, indicating that there was minimal correlation between possible chemical stressors and population conditions. The results provided no evidence for chemical risk conditions during the sampling period in 1994.

Sampling captures aquatic population conditions during certain periods. Because the monitoring was completed over a short duration, it may not represent the year-round condition. In addition, the sampling took place prior to accelerated action efforts (e.g., removal of sediments from ponds B-1, B-2, and B-3) and likely represents worst-case conditions as compared to current conditions.

3.3 Exponent, 1998

Final Report: Lower Walnut Creek Aquatic Sampling for the Rocky Flats Environmental Technology Site.

Review

The objectives of this study of lower Walnut Creek were to determine the quality of aquatic habitat and richness and abundance of benthic macroinvertebrates; identify the fish species present; determine the condition of the benthic macroinvertebrate and fish populations; and compare these results to downstream areas. One site within RFETS and five sites located east (downstream) of RFETS were investigated. EPA-approved Rapid Bioassessment Protocols (RBP) were used to measure physical habitat characteristics, and habitat was then rated as optimal, suboptimal, marginal, or poor. Substrate composition and relative amounts of micro-habitats also were measured. Fish sampling was conducted during spring using seines and minnow traps. Macroinvertebrate sampling occurred in spring using kick nets to sample riffle, run, pool, and bank habitats. In addition, a Hess sampler was used in appropriate habitat. Except for one sample location, sampling was conducted at locations downstream of Great Western Reservoir. Site D1, located just west of Indiana Street is the only sample within the RFETS boundaries.

The study concluded that aquatic habitats and aquatic life in Walnut Creek are limited by stream flow, especially at the upper transition zone sites such as D1. Altered flow conditions due to water management are a primary limiting factor for habitats and the development of an aquatic community. Site D1 had the lowest overall habitat score due to low proportion of riffle habitat and high proportion of silt in the substrate, among other factors.

Benthic macroinvertebrate metrics from site D1 indicate the presence of environmental stress. Low taxa richness, low EPT index values, high percentage contribution from dominant taxa, and overall low number of organisms contribute to the above observation of stress. The document cites the lack of water as the primary factor for the reduced quality of the benthic community at site D1. The fish community at site D1 is described as transient, and again, it is considered to be due primarily to inadequate flows. .

The RFETS site (D-1)had more tolerant and hardy macroinvertebrate taxa compared to the downstream sites. This may have been an indication of the water management at RFETS, which often alternates periods of no flow to moderate flow and back to no flow within a short period.

Application to the CRA and Uncertainties

The study concluded that the observed species in Walnut Creek were controlled/affected by the intermittent flows in the creek. This study provides more evidence that RFETS aquatic communities in lower Walnut Creek are limited by the physical conditions of the streams and ponds due to very limited or manipulated flows. On-site water management and the general arid conditions limit the types of aquatic communities that are possible at RFETS. This study described the aquatic condition within the lower portions of the Walnut Creek watershed. They do not reflect conditions within RFETS, but rather the conditions just inside the boundary to off-site down-gradient areas. The findings of this study must be viewed with caution because there was only one sampling event in the spring of 1998 and, thus, it is a “snapshot” of the creek condition. The authors recognized the limitations of the study and recommended that further studies be completed. Habitat conditions of a stream can change rapidly over a season and can vary from year to year. The trend in the fluctuation of habitat and aquatic communities should be known in order to determine if conditions at RFETS are improving or declining.

3.4 Aquatics Associates Inc., 1998

Interim Report: Results of the Aquatic Monitoring Program in Big Dry Creek, 1997.

Review

An aquatic monitoring program was initiated in 1997 for the Cities of Broomfield, Northglenn, and Westminster to document the abundance and distribution of fish and aquatic macroinvertebrate populations in Big Dry Creek downstream of Standley

Reservoir. The study was needed to establish a database of aquatic conditions and to help determine appropriate surface water standards for Segment 1 of Big Dry Creek.

Fish sampling was performed by the Colorado Division of Wildlife using electroshocking equipment. Fish population data collected in the spring and fall of 1997 were analyzed and summarized. A list of species collected, including mean lengths, mean weights, and relative abundance, was developed for each station and sampling occasion.

Aquatic macroinvertebrates were collected at locations corresponding to fish sampling sites. Methods included Hess sampling in shallow riffle areas and kick net sampling in riffle, run, pool, and bank microhabitats. Samples were processed and preserved by City of Northglenn staff. Identification, enumeration, and analysis of aquatic macro-invertebrate samples were performed by Aquatic Associates Inc.

Seven study sites were selected for this investigation, three upstream of city wastewater treatment plants and four at or below the effluent for the treatment plants. Big Dry Creek was characterized as a transition zone foothills-plains stream in areas upstream of the treatment plants. The reach below the treatment plants was characterized as a plains stream type.

A total of 17 species of fish were collected over the two sampling seasons. Nine of the fish species collected in the Big Dry Creek in March and October 1997 are native to streams in the South Platte River Basin. Native species collected included longnose dace (*Rhinichthys cataractae*), creek chub (*Semotilus atromaculatus*), fathead minnow (*Pimephales promelas*), sand shiner (*Notropis stramineus*), white sucker (*Catostomus commersoni*), longnose sucker (*Catostomus catostomus*), brook stickleback (*Culaea inconstans*), green sunfish (*Lepomis cyanellus*), and Johnny darter (*Etheostoma nigrum*). Of the nine native species observed in Big Dry Creek, five species (longnose dace, creek chub, white sucker, longnose sucker, and Johnny darter) are common to cool water environments in transitional foothills-plains stream types. Most of the native fish collected in Big Dry Creek were classified as either abundant or common in a recent inventory of streams in the Front Range and eastern plains conducted by the Colorado Division of Wildlife. Conclusions from the biological assessment portion of this study suggested a relatively low risk of imperilment for most native fish species.

The aquatic community of Big Dry Creek was represented by 18 orders of macroinvertebrates, including a total of 113 taxa. Diptera (midges and flies) were predominant at all sites in March. Diptera and Oligochaeta (aquatic earthworms) were abundant at all sites in October. Essentially, the fauna present upstream of the Broomfield Treatment Plant was representative of a transitional foothills-plains stream, while in downstream areas the aquatic community was more representative of plains stream habitats. Physical habitat and fluctuating stream flows most likely limit the macroinvertebrate community in Big Dry Creek, particularly in the low-gradient areas downstream from the Broomfield Treatment Plant, where riffle habitats with cobble substrate are sparse and much of the streambed is channelized.

Application to the CRA and Uncertainties

Streams at RFETS are the same type (i.e., transitional foothills-plains streams), as those in the upper portion of Big Dry Creek. Conclusions from this study that flows from RFETS via Walnut and Woman Creeks are not causing a risk to aquatic life in downgradient locations. This will be used as a line of evidence for the Walnut Creek and Woman Creek AEUs.

The study of Big Dry Creek represents only one year of aquatic community data, presenting uncertainty of the overall health of the streams and year-to-year fluctuations in fish and macroinvertebrate populations. Additionally, Big Dry Creek is influenced by adjacent real estate development and changing stormwater conditions that are not present at RFETS.

3.5 Kaiser-Hill, 1999, 2000, and 2001

Annual Wildlife Survey for the Rocky Flats Environmental Technology Site.

Review

Fish surveys were conducted using minnow traps in streams and ponds over three consecutive years. The purpose of these surveys was to determine whether previously recorded fish species (Ebasco 1992) were still present within RFETS streams. Ten stream locations within each drainage (40 over the entire site) were systematically surveyed in each drainage during May 1998 based on water availability. Ponds were not surveyed. In early summer 1999, ponds and impoundments were surveyed. In summer 2000, Rock Creek was surveyed again. Nine stream locations were selected based on the availability of water in this ephemeral stream. Traps remained at each location for a minimum of 2 days and were checked by afternoon of each day. Any aquatic or semi-aquatic vertebrates captured in the traps were identified and enumerated before being released.

Selection of sampling locations was limited by water availability. In 1998, locations in Rock Creek were clustered because large sections of the creek were dry. It was determined that surveys in Rock Creek should be conducted during another year when conditions were better. Therefore, Rock Creek was surveyed again in 2000.

During the 1998 surveys, fathead minnow (*Pimephales promelas*) were captured in all major drainages at RFETS (Table A7.7). This included locations in Rock Creek, Lower Walnut Creek, Upper Woman Creek, and Lower Smart Ditch. Additionally, creek chub (*Semotilus atromaculatus*) and stoneroller (*Campostoma anomalum*) were captured in Upper Woman Creek. The greater variety of fish species in Woman Creek was attributed to the relatively large seep-wetland complexes that discharge into the Woman Creek drainage. Due to these conditions, a greater portion of Upper Woman Creek has sustained water flows. Not all survey locations had fish observations. Notably, McKay ditch had no fish present, and Walnut Creek above the A-series ponds had no fish.

Pond and impoundment surveys in 1999 revealed fathead minnows in all locations, though it is unclear if all ponds and impoundments were surveyed. In Pond C-1, fathead minnows, smallmouth bass (*Micropterus dolomieui*), and creek chub were captured. It is noteworthy that largemouth bass were collected just below Pond C-1 during the baseline study (Ebasco 1992). This suggests that the bass observed in 1999 may have been misidentified. This study, along with the earlier stream surveys, demonstrates the higher species richness in Woman Creek compared to other RFETS drainages. In Rock Creek, largemouth bass (*Micropterus salmoides*) were captured in the Lindsay Pond.

When Rock Creek was surveyed again in 2000, sites were located in a more systematic fashion and better represented stream habitats throughout the drainage. Fathead minnows were the only species captured at eight of the nine survey locations. Only the location furthest downstream on Rock Creek did not have fish. Higher numbers of fathead minnows corresponded to the upper reaches of the stream.

With the exception of the bass observations, all fish species observed during the baseline study (Ebasco 1992) were observed again over this 3-year survey and found in the same general locations as they were in 1992. Other animal taxa also were recorded over the 3 years. Leeches, crayfish, garter snakes, and leopard frogs were observed.

Application to the CRA and Uncertainties

These studies indicate that all the RFETS streams are intermittent and that perennial flows and better aquatic habitats occur in the upper reaches of these streams. Overall, fish species richness is very low at RFETS, and similar to what has been reported for other small streams in this semi-arid region.

The studies also confirm that fish species are present with the same richness and in the same general locations as they were nearly a decade earlier. The years 1998 through 2000 were very dry in terms of precipitation, and it is interesting to note that drought conditions presented a problem in finding enough sites to sample. This reinforces the point that habitat, especially water availability, limits fish communities at RFETS. This information was used as a line of evidence for NW AEU, SW AEU, WC AEU, and Rock Creek (RC) AEU that aquatic life is controlled by physical habitat limitations such as flow.

3.6 Aquatics Associates Inc., 2003

Results of the Aquatic Monitoring Program in Streams at the Rocky Flats Site, Golden, Colorado, 2001-2002.

Review

The purpose of this study was to characterize the existing aquatic communities (fish and macroinvertebrates) and physical habitat conditions in streams within the Walnut, Woman, and Rock Creek drainages in order to provide a baseline for monitoring the potential influences of site closure activities. Sampling in ponds did not occur. RBPs were used to measure physical habitat characteristics, and habitat was rated as optimal, suboptimal, marginal, or poor. Substrate composition and relative amounts of micro-habitats were measured to supplement the RBP habitat analysis. Fish sampling was conducted during summer and/or fall using backpack electroshocking equipment. Macroinvertebrate sampling occurred in spring, summer, and fall using kick nets to sample riffle, run, pool, and bank habitats. Study sites included five locations on Walnut Creek, and four on Woman Creek and Rock Creek. Results are summarized herein for Walnut and Woman Creeks. One site (WC1) is located in the NW AEU, four sites are located in the SW AEU (WC2, WC3, WC4, and WC5), and four sites are located in the WC AEU (WO1, WO2, WO3, and WO4).

Habitat scores for each site are presented in Table A7.8. The lower scores at sites WC2, 3, 4, and 5 in Walnut Creek reflect the generally poor condition of the stream banks, and for WC4 and WC5 the condition is further diminished due to the periodic discharges from the terminal ponds. Habitat in Walnut Creek at WC1 was generally rated as higher and comparable to Woman Creek sites WO1 and WO2. Permanent water is found at sites WO1 and WO2, but flows are generally low and seasonally intermittent, and the habitat quality decreases primarily due to diminishing flows during the summer months.

Habitat data collected in 2001 and 2002 were compared to data from November 1994 and 1995 from Wright Water Engineers 1995). Aquatic Associates (2003) reported that the same general trends in scores were evident for the Walnut Creek drainage with the highest score reported for a North Walnut Creek site near WC1. Lower scores were found for several sites on South Walnut Creek near WC3) and the mainstem downstream to Indiana Street Pond (near WC4 and WC5). High scores were reported for WO1 and WO2 and WO3 from the earlier work.

Woman Creek has more natural flows in the upper reaches. Below the C-2 pond, flows are greatly reduced and heavily influenced by pond releases and water management. The natural flows in the upper reaches are seep-fed and also influenced by seasonal precipitation. Rock Creek has natural seep-fed flows.

In the effluent-dominated reach of Upper Walnut Creek and the discharge-dependent Lower Walnut Creek, bank erosion results in poor bank stability and sediment inputs to the stream, which negatively affects physical habitat and aquatic life. Stream bank erosion was further aggravated by the periodic discharges from the terminal ponds.

Fish were sampled from nine locations in Walnut, Woman, and Rock Creeks in August 2001 and found at 7 of the nine locations. Fish abundance and distribution in these streams is severely limited due to the lack of permanent water. Naturally self sustaining fish populations, defined as a number of age classes present, were found at four sites, WC3, WO1, WO2, and RC2 (Table A7.8). Fathead minnow was the only fish population found at WC3.   A stable and healthy creek chub population was found at the upper two sites in Woman Creek. No fish were collected at WC1, WC2, or WC4 and only one fathead minnow was collected at site WC5. Resampling in October 2001 produced no additional fish at WC4 and WC5. Compared to studies conducted in 1991, similar results were found with fathead minnow being the only species found in Walnut Creek. In Woman Creek, creek chubs were found in 2001 and 1991, while in 1991 several additional species were collected (See Ebasco 1992).

Macroinvertebrates were collected in summer and fall 2001 and spring, summer, and fall 2002. The macroinvertebrate community was comprised mainly of hardy and tolerant species. The dominant organisms were similar in each drainage, with oligochaetes most abundant in Woman Creek and dipterans most abundant in Walnut Creek. Ephemeroptera were relatively abundant throughout the drainages and included moderate to tolerant species. Trichoptera (caddisflies) in Walnut Creek were generally present in higher numbers compared to other RFETS drainages, likely due to the effluent-dominated flows. Amphipods are also found in higher numbers in Walnut Creek, thriving in the slower moving or standing water environments provided by the ponds.

The Hilsenhoff Biotic Index (HBI) values from the samples collected from each creek were typically greater than 6, which is suggestive of higher degrees of organic pollution. In Walnut Creek HBI values ranged from 5.07 to 9.45. HBI values were typically higher in Woman Creek than in Walnut Creek ranging from 5.63 at site WO1 (spring 2002) to 9.38 at site WO3 (fall 2002). The high HBI value at WO# was due to the highly tolerant tubificid worm which comprised nearly 96% of the entire macroinvertebrate sample in fall 2002.

Invertebrate Community Index (ICI) ratings were also used to rate invertebrate community conditions and quality. Scores greater than 46 are considered to represent exceptional community conditions, while 36 -45 represents good conditions, 13 – 35 represents fair conditions, and 12 or less represents poor conditions.

ICI scores for Walnut Creek indicated a moderately stressed benthic macroinvertebrate community. Mean ICI scores ranged from 14 to 29.6 for individual sites. The highest mean score was at site WC3 where stream flows are stable and consistently higher than at the upper two sites. Of all the sites, flows are most suitable at site WC3 providing the most favorable habitat. Sites WC4 and WC5 had the lowest mean ICI scores at 16 and 14, respectively, likely due to interrupted flow regime.

ICI scores in Woman Creek indicate a stressed macroinvertebrate community in 2001 and 2002. Six of 13 sampling events had scores in the poor. Site WO3 had the lowest ICI scores with a value of 2 in fall 2001 and 0 in fall 2002. Six of the scores were rated as fair, ranging from 14 to 34. Only one score was in the good category (40 at site WO1 in fall 2001). Mean ICI scores indicate the macroinvertebrate community in Woman Creek is the most stressed of the three drainages studied. Scores were 22.4, 15.6, 8.7 at sites WO1, WO2, and WO3, respectively, with the WO3 score indicating stress due to the lack of permanent water.

Findings from the study indicated that all of the streams at Rocky Flats are flow limited. Perennial flows are typical in the upper reaches of all three drainages, and flows diminish considerably in downstream reaches where the streams become largely intermittent. In the upper reaches where flows are perennial, habitat assessment scores were generally highest, indicating overall better habitat quality. A combination of natural and anthropogenic influences on the hydrological regimes of these systems significantly influences the quality and quantity of habitat available for aquatic life. Aside from the flow limitations in all drainages, additional limitations on the physical habitat quality include effluent dominated and discharge dependent areas of South Walnut and Walnut Creeks, respectively, bank erosion and poor bank stability, and sediment inputs. Stream bank erosion is further aggravated by the periodic discharges from the terminal ponds.

A comparison of study results to earlier studies of Rocky Flats streams showed that community structure and abundance were generally similar to those found in Walnut, Woman, and Rock Creeks during the 2001- 2002 study and are similar to other transitional foothills-plains and plains type streams. Like Wright Water Engineers (1995), Aquatics Associates (2003) concluded that intermittent flows were the major limiting factor for sustaining a healthy and balanced macroinvertebrate community in lower Walnut Creek.

Application to the CRA and Uncertainties

This study concluded that, within the aquatic habitats present in Walnut and Woman Creeks, whether perennial or intermittent, aquatic communities are comparable to communities found at other locations at RFETS and within the region. Only one fish species is prevalent (fathead minnows) and the manipulated nature of the ponds and streams precludes the establishment of large or diverse fish populations. Macroinvertebrate populations do not appear as affected, likely due to their ability to re-colonize newly inundated habitats and their comparatively shorter life cycles. Macroinvertebrate communities in Walnut Creek and Woman Creek are similar to those found in Rock Creek. This supports the line of evidence that Walnut Creek and Woman Creek aquatic communities are healthy, albeit limited, and these creeks are capable of sustaining benthic communities comprised of hardy and tolerant species adapted to the limiting environmental conditions. The results provide no evidence for effects of chemical stressors impacting the ecological setting within these streams. The study was used as a line of evidence for NN AEU, NW AEU, SW AUE, and WC AEU with regard to populations and overall ecosystem health.

The detention ponds were not sampled in this study. The RBP methods are not intended to sample large ponds. Therefore, conclusions about the aquatic health of the ponds cannot be made without some uncertainty. Only one sampling location was established in North Walnut Creek, and it was located above the A-series ponds. Because the ponds represent a significant habitat portion of the aquatic areas within RFETS, the lack of pond sampling presents uncertainty in the use of this study as a line of evidence.

3.7 Wright Water Engineers, Inc. 2003

Supplemental Biological and Selected Water Quality Data Exploration, 1997-2001.

Review

This study was summarized as a technical memorandum that was presented to the steering committee evaluating water quality conditions within Big Dry Creek. Information in the memorandum was taken from a Wright Water Engineers report entitled, “Integrated Analysis of Habitat, Macroinvertebrate, Fish, Flow and Selected Water Quality Parameters in the Main Stem of Big Dry Creek” (WWE 1994). The memorandum provides a supplemental evaluation to the Wright Water Engineers report.

The study used RBPs to sample macroinvertebrate communities, periphyton, and fish in streams and rivers. Results from the sampling conducted from 1997 to 1999 were incorporated and compared to a 5-year expanded database for Big Dry Creek.

The purpose of the assessment was to develop an understanding of the factors influencing aquatic life in the creek and to determine whether a more stringent unionized ammonia standard was necessary to protect the Johnny darter (Etheostoma nigrum). The levels of unionized ammonia in the creek did not appear to be affecting the fish or macroinvertebrate communities, based on concentrations present in the creek during the last 5 years. Unionized ammonia levels in the creek are generally below the stream water quality standard.

Overall, upper reaches of Big Dry Creek have higher quality fish and benthic communities than downstream locations. Upstream locations also generally have higher habitat scores, better water quality, and lower flows. This is expected for a stream such as Big Dry Creek as it transitions from a foothills to a plains stream with an associated increase in sediment load and reduction in riffle quality and habitat diversity.

Although iron periodically exceeds the stream water quality standard, it does not appear to be affecting the fish and benthic communities. Dissolved selenium concentrations do not appear to be adversely affecting the fish and benthic communities based on the limited sample size reviewed. Selenium testing has just been added to the program over the last few years. Lead is not included in the study because concentrations of lead prior to initial assessments had not exceeded the water quality standards.

Habitat appears to be the most consistent influence on benthic communities, whereas fish communities do not seem to be influenced by any of the variables explored. Fish index of biotic integrity (IBI) scores in Big Dry Creek are improving over time. However, habitat alone does not fully explain benthic community health. Artificial substrate samples showed stronger relationships to flow, total suspended solids (TSS), and location than did other benthic samples taken from natural conditions.

Application to the CRA and Uncertainties

This technical memorandum and review of data from areas downstream of RFETS in Big Dry Creek illustrate many of the conditions seen at RFETS. Stream habitat quality is higher and corresponding benthic and fish communities are healthier in the upper reaches of streams compared to lower sections. Water entering into the Big Dry Creek drainage via Walnut and Woman Creeks is of good quality albeit influenced by the large buffering affect of Standley Lake Reservoir and Great Western Reservoir. The negative affects of flows, including increased TSS, are not observed until greater flows occur and runoff is received form surrounding urban land uses.

3.8 Wright Water Engineers, Inc. 1995

Bioassessment and Physical/Chemical Characterization of Walnut Creek and Woman Creek. Rocky Flats Environmental Technology Site

Review

A bioassessment and an analysis of the physical and chemical characteristics of Walnut and Woman Creeks within the boundaries of the Rocky Flats Environmental Technology Site (WETS) was conducted to compare the overall ecologic health of Walnut Creek between Pond A-4 and Indiana Street to an analogous reach of Woman Creek. The study quantified biological, chemical, and physical characteristics of the two streams and evaluated the potential causes of variations in the aquatic communities along these creeks. The study also evaluated whether unionized ammonia discharges from the WETS wastewater treatment plant could be impacting aquatic life in the receiving ponds or in the segment of Walnut Creek below the ponds. For this study, the methods and procedures for conducting a Rapid Bioassessment Protocol III for stream impairment assessment in Rapid Bioassessment Protocols for Use in Streams and Rivers (EPA 1989) were followed to the extent possible. Data included in this assessment came from the 1991 Baseline Assessment (Ebasco 1992) and surveys conducted by DOE in 1994.

The study found that the macroinvertebrate community in Walnut Creek downstream of the A and B-series ponds and upstream of Indiana Street is not as diverse or robust as that in Woman Creek above the Mower Diversion. Recent observations indicate that there is no macroinvertebrate community in this segment of Walnut Creek, except for the very downstream reach (approximately the last 500 feet upstream of Indiana Street), or in Woman Creek below the Mower Ditch, due to the lack of consistent flow. Fish species were not found in Walnut Creek below Pond A-4, due to a lack of flow. Only a single minnow species was found in any of the ponds tributary to lower Walnut Creek or in the pond at Walnut Creek and Indiana Street.

Habitat of Walnut Creek below the A- and B-series ponds is of lower quality than that of Woman Creek, and large differences exist in substrate, the presence of habitat types, and the diversity and productivity of the riparian zone. These habitat differences are persistent, and would not change significantly with a change in flow regime.

An analysis of water chemistry and benthic sampling data indicate that the macroinvertebrate community in Walnut Creek below Pond A-4, and continuing downstream to the confluence with Big Dry Creek, is not adversely affected by ammonia concentrations during periods of release from Pond A-4, particularly when flow ceases on this stream segment. Data also indicate that the characteristics of aquatic life in the pond in Walnut Creek at Indiana Street are generally similar to those in the A- and B-series ponds directly affected by wastewater discharges (Ponds B-3, B-4, B-5, and A-4), even though these upper ponds have experienced much higher un-ionized ammonia concentrations. While the biological health of the pond in Walnut Creek at Indiana Street is primarily limited by flow considerations, the biological health of the A- and B-series ponds is impaired by operational practices and stratification phenomena. Large water fluctuations in these ponds impair the development of stable habitat, and previous water quality investigations have documented that these ponds experience wide swings in pH and significant oxygen depletion at depth during seasonal periods of stratification. These factors likely prevent a greater abundance or diversity of fish species.

Since aquatic life exists in reaches of Walnut Creek between Pond A-4 and Indiana Street where there is water, and aquatic life could be sustained in the reach with increased flow conditions, the study concludes that the current aquatic life classification for this reach is appropriate. The report also concludes that there are significant biological and physical differences between this reach and the corresponding reach of Woman Creek.

The report further concludes that the lack of fish species and the current impairment of the macroinvertebrate community in Walnut Creek between Pond A-4 and Indiana Street is primarily caused by a lack of flow and by poor habitat conditions, which would not improve to the level observed in Woman Creek even with increased flow. The study found no obvious correlations between un-ionized ammonia concentrations and calculated metrics. Furthermore, operational practices at the ponds result in frequent and severe fluctuations in water level and, combined with a seasonal and persistent depletion of oxygen, significantly limit the ability of these ponds to support fish life. For these reasons, existing ammonia concentrations are not considered a significant cause of impairment in the ponds or in the reach of Walnut Creek below the ponds.

Application to the CRA

This study can be used as a line of evidence for NN AEU, NW AEU, SW AUE, and WC AEU with regard to populations, habitats, and overall ecosystem health. The lack of fish species and the current impairment of the macroinvertebrate community in Walnut Creek between Pond A-4 and Indiana Street is primarily caused by a lack of flow and by poor habitat conditions. Operational practices at the ponds result in frequent and severe fluctuations in water level and, combined with a seasonal and persistent depletion of oxygen, significantly limit the ability of these ponds to support fish life.

4.0 BIOASSAY ANALYSES

4.3 DOE, 1996

Final Phase I RFI/RI Report. Woman Creek Priority Drainage, Operable Unit 5. Appendix N. Ecological Risk Assessment for Woman Creek and Walnut Creek Watersheds at the Rocky Flats Environmental Technology Site.

Review

This study was completed as part of the ecological risk evaluation of aquatic life for OUs 5 and 6. Risks to aquatic life from chemical concentrations in sediments were evaluated by a weight-of-evidence approach. HQs and HIs were generated as a screening tool, and indicated a relatively high potential for toxic effects in sediments. As a next step in the multi-tiered ERA process, characteristics of benthic community structure and results of sediment bioassay tests were used to check predictions of toxic stress as indicated by the screening results. The results of the community characteristics were summarized in Section 3.1; the results of the bioassay analysis are presented here.

Laboratory sediment toxicity tests were conducted on composite sediment samples collected from each pond during October and November 1992. Whole sediment tests following protocols outlined in Nelson et al. (1990) were used for 28-day exposure of the amphipod *Hyalella azteca* and for 10-day exposure of the dipteran *Chironomus tentans*. Fine sands were used as controls. Sediments from the A-, B-, and C-series ponds were tested with *Hyalella azteca*. Toxicity tests using *Chironomus tentans* were limited to Ponds A-3, A-4, B-3, B-4, and B-5 due to reduced availability of acceptable test organisms. Toxicity test results reported by DOE (2004b) were based on information provided to the RFETS Surface Water Division in documents submitted by The Seacrest Group of Broomfield, Colorado. The DOE report (2004b) acknowledged the possible need for further review of the test results in order to evaluate test validity and statistical results.

Bioassay results for Pond B-2 sediments indicated that survival of *Hyalella azteca* after 28 days of exposure (64 percent) was significantly lower than in controls (85 percent) (t=3.72, t0.05 =2.18). No toxic effects were observed for *Hyalella azteca* or *Chironomus tentans* in any other sediment exposures. Table A7.9 presents a summary of the bioassay test results.

Control survival for H. azteca was less than the acceptable 80 percent limit for tests of the A-1, A-2, A-5, C1, and C2 sample sediments. Despite control survival falling below the acceptable limit, sediments from these samples all exhibited relatively high organism survival, ranging from a low of 80 percent in C-1 sediments to 96 percent in C-2 sediments. Sediments from Pond B-5 had the lowest organism survival (e.g., 60%), however, data from the report suggests that survival for this test was not significantly different than control survival.

Overall, H. azteca survival in all tests, except for tests using sediments from B-2, B-5, and A-3 were 80 percent or higher. Treatment survival in tests using sediments from A-1, A-4, B-1, B-4, C-1, and C-2 was 90 percent or higher.

Growth data for H. azteca were not statistically evaluated. However, with the exception of one test for sediments from Pond B-3, all H. azteca mean weights in pond treatment sediments were higher than their corresponding control treatment weights.

Chironomus survival in those sediments tested ranged from 62 percent to 103 percent (sediment sample was not adequately screened to remove all "native" chironomid larvae)and comparisons to control survival indicated no significant reductions.

Sediment bioassays indicated toxicity only in sediments from Pond B-2. These results are not consistent with the high levels of toxicity indicated by HQs and HIs, especially in Ponds A-1 and B-1. Table A7.10 presents a comparison of NW AEU contaminant EPCs and contaminant concentrations in sediments used for toxicity testing. The lack of toxicity, except for one site, and the relatively comparable concentrations of ECOPCs suggests that despite HI >1, sediments from these ponds were not toxic.

Application to the CRA

This study determined that, despite predictive risk analysis of chemicals using HQs and HIs, the actual toxicity was low. It appears that the chemicals present within the sediment were not bioavailable and did not yield a toxic response. Furthermore, the HI for the Pond B-2 was the second lowest of the B-series ponds, containing lower concentrations of all sediment ECOPCs and PCOCs that exceeded sediment quality criteria than in Ponds B-1, B-3, or B-4. This points to the uncertainty inherent in using HQ and HI tools in determining realistic risk conditions. HQs and HIs may suggest a potential concern, whereas the actual risk in the is low.

Sediments from the A-, B-, and C-series ponds were tested with Hyalella azteca. Toxicity tests using Chironomus tentans were limited to Ponds A-3, A-4, B-3, B-4, and B-5 due to reduced availability of acceptable test organisms. The results will be used as a line of evidence for the ponds tested, as a direct measure of sediment toxicity. The study was completed during the timeframe from which the CRA data sets were derived. Therefore, the results represent a snapshot in time that is relevant to the CRA findings.

The period in which this study was completed represents an historic condition at RFETS. A significant number of accelerated action efforts have been completed since this time. The samples tested are a small set of the collected media samples and may not represent the entire drainage system. Therefore, these results may be over- or under-conservative. In addition, the sampling represents a single event in time and likely does not represent year-round conditions or current conditions. Although these are historical results, they indicate that earlier, pre-remediation conditions did not demonstrate toxicity. It is likely that current pond and stream conditions are comparably nontoxic.

4.4 Wolaver et al. 1993

Toxicity Monitoring in Rocky Flats Plant Surface Waters May 1991 – June 1992

Review

A Surface Water Toxicity Monitoring Program (SWTMP) was initiated in May 1991 by the Rocky Flats Plant (RFP) Environmental Protection Management Surface Water Division. The SWTMP was conducted from May 1991 to June 1992. Aside from the need to meet regulatory requirements, the SWTMP was also conducted to establish a baseline water quality characterization using two independent toxicity tests for selected surface water locations, investigate correlations of toxicity measurements and water chemistry/weather data analyses, and develop a real-time water quality monitoring method by comparison of results from Microtox tests to the EPA-required WET tests.

Whole Effluent Toxicity (WET) testing were conducted on samples from the 995 effluent, terminal pond effluent (A-4 discharge and B-5 Tra*n*s), and terminal in-pond grab (A-3, A-4, B-5, and C-2). Incoming raw water, Protected Area and non protected area waste streams at the equalization basins, influent to the STP, A-1 bypass, and the A-, B-, and C-series pond samples were submitted for Microtox testing.

WET tests includes 48-h static acute Ceriodaphnia and 96-h static renewal acute *Pimphales promelas* exposures. The endpoint was mortality. Microtox tests include exposures of the marine bacterium *Photobacterium phospherum*, which is an illuminescent bacteria. Toxicity is based on reduced measurement of light output, thus the endpoint for the test is a 50% metabolic inhibition in a 15-minute acute test.

WET test results for Ceriodaphnia and *P. promelas* indicate no toxicity for samples from the A- and C-series ponds. In the B-series ponds sampled (Pond B-5), 7.7% and 15.4% of samples tested for Ceriodaphnia and fathead minnow exhibited toxicity; toxicity was identified to be due to ammonia. Toxicity tests for the B-5 transfer samples indicated slight toxicity in >80% effluent dilutions for fathead minnow only. Samples from the 995 effluent indicated toxicity in 14.3% and 46.2% of samples for Ceriodaphnia and fathead minnow, respectively. Toxicity to Ceriodaphnia was inversely correlated with COD while toxicity to fathead minnow was inversely correlated to toluene and acetone in surface waters.

Toxicity as measured by Microtox was observed at some point in time from each of the sampling locations except at Pond C-1 and Pond B-4. Following is a summary of the toxicity characterization presented in the report as it relates to Microtox testing:

A-Series Ponds

Microtoxicity observed in 25% of the Pond A-1 samples (n=12), 15.4% of the Pond A-2 samples (n= 13), 5.9% of the Pond A-3 samples (n=17), and 10.3% of the Pond A-4 samples (n= 29). The frequency of toxicity in Pond A-1 samples was statistically different than that in the raw water pond, while Ponds A-2, A-3, and A-4 were statistically no different from the raw water pond.

B-Series Ponds

Microtoxicity observed in 14.3% of the Pond B-1 samples (n=14), 42.9% of the Pond B-2 samples (n= 14), 7.7% of the Pond B-3 samples (n=13), 0% of the Pond B-4 samples (n= 13), and 11.1% of the Pond B-5 samples (n= 27). The frequency of toxicity in all B-Series ponds was statistically no different than that in the raw water pond.

C-Series Ponds

Microtoxicity observed in 0% of the Pond C-1 samples (n=12) and 9.7% of the Pond C-2 samples (n= 32. . The frequency of toxicity in all C-Series ponds was statistically no different than that in the raw water pond.

Application to the CRA

At locations where ecological receptors are likely to be exposed to ECOPCs, primarily the A-, B-, and C-series ponds, WET testing indicates no toxicity for A- and C-Series pond samples during the course of the investigation. In the B-Series Ponds (Sample from Pond B-5 only) indicated WET which was later identified to be due to ammonia. These test results suggest that surface water in the A, B, and C series of ponds exhibited little or no toxicity to test organisms and were not likely to adversely impact specie inhabiting these locations.

5.0 WATERFOWL/WADING BIRD STUDIES

5.3 DOE, 1996

Final Phase I RFI/RI Report: Woman Creek Priority Drainage, Operable Unit 5. Volume 5. Appendix N Ecological Risk Assessment for Woman Creek and Walnut Creek Watersheds at the Rocky Flats Environmental Technology Site.

Review

As part of the multi-tiered ERA provided in this study, an evaluation of potential risk to waterfowl and wading birds was completed using standard screening-level risk methods. The mallard and great blue heron were selected to represent aquatic-feeding wildlife because they are common species and known to occur at RFETS. In addition, birds are generally more sensitive than mammals to organic contaminants because they lack the same capacity for detoxification and therefore represent a more conservative exposure and risk scenario. Exposure of these two receptors was assessed by using measured concentrations of contaminants in biota or by estimating the transfer of contaminants from sediments to prey species. The purpose of this study was to determine whether ecological contaminants of concern (ECOC) concentrations in surface water and sediments of the detention ponds could result in exposures that reduce the survivorship or reproductive capacity of aquatic feeding birds.

The primary exposure pathways evaluated for both birds were the ingestion of food, surface water and sediment. Herons feed primarily on fish. Amphibians and invertebrates are usually minor components of their diets but can be important in localized areas. Herons have relatively little direct contact with sediments during feeding. Mallards have more contact with sediments because they may feed by filtering plant material and invertebrates.

The document provides the detailed methods used for the evaluation of exposure for the Heron and mallard. Assumed exposure rates, area use factors etc., are all thoroughly described within the original document and are summarized in Table A7.11.

The risk characterization was based on exposure and risk to individual birds because both great blue herons and mallards are protected under the Migratory Bird Treaty Act. The exposure and risk evaluation was conducted under two exposure scenarios: 1) current aquatic community structure and contaminant distribution; and 2) more complex aquatic communities that could result in increased biological transport of sediment contaminants and increased PCB concentrations in prey.

Two methods were used to determine the potential risk to the mallard and great blue heron. The first relied on available, current tissue data The second used a modeling approach to extrapolate and determine potential prey tissue burdens for aquatic areas that did not have measured values due the lack of prey species at the time of the study.

DOE (1996) indicated that birds and mammal feeding in aquatic habitat may experience higher contaminant exposures than their terrestrial-feeding counterparts, primarily due to three factors. The factors include; 1) erosion and groundwater transport may cause contaminants to accumulate and focus in watersheds; 2) patches of aquatic habitats are usually small relative to terrestrial areas and aquatic-feeding wildlife tend to concentrate in areas of suitable habitat; and 3) bioconcentration and bioaccumulation of chemicals in aquatic organisms can lead to toxic exposures even when concentrations in abiotic media are relatively non-toxic or when contact with the contaminated media is limited.

Adequate biota samples were collected in Ponds A-2, A-3 and A-4. Sampling was conducted in Pond A-1 but insufficient volumes of tissue for analytical analysis were obtained.   All ponds were limited in the number of taxa available for collection. In pond A-2, largemouth bass were collected, but they were not available in pond A-3 or A-4 where either flathead minnows or crayfish were collected. Pond A-2 represented the most complete dataset with largemouth bass, crayfish and benthic macroinvertebrates.

Chemicals identified as ECOCs for aquatic feeding birds included di-n-butylphthalate, PCBs, mercury, and antimony. Potentially significant risks to the heron were predicted in all source areas evaluated in the initial screening-level risk assessment. Risks were driven by mercury, di-n-butylphthalate and antimony, primarily due to estimated tissue concentrations. For the mallard, screening-level risks were highest in the A, B and C-series ponds, primarily driven by estimated exposure to di-n-butylphthalate in invertebrate tissues.

Table A7.12 presents the Hazard Indices (HIs) calculated in the screening-level risk assessment. The HQs that were use to calculate the HIs are presented in Tables A7.13 and A7.14 along with their relative contribution to the HI.

The following specific objectives for the risk characterization for the heron and mallard were outlined based on the results of the screening-level risk assessment in DOE (1996) as follows:

- Estimate current exposure using chemical concentrations in sediment and biota. Exposures were estimated for each pond in which contaminants were detected.
- *Estimate site-specific biota:sediment PCB concentration ratios.* Lipid:sediment organic carbon ratios were used to estimate uptake and tissue concentrations in ponds that currently lack fish.
- *Develop remediation criteria for sediments.* Since it was determined to be the only bioaccumulative chemical with the potential to cause risk, concentrations of Aroclor-1254 in sediments intended to be protective of herons and mallards were estimated from site-specific concentration ratios. Multiple criteria were calculated for a range of site-use scenarios to aid in decisions on remedial actions.
- *Evaluate exposure of receptors in di-n-butylphthalate in aquatic prey.* Concentrations of di-n-butylphthalate in abiotic media were used in each pond where they were detected. Bioconcentration of di-n-butylphthalate was estimated for each pond using surface water data.

The risk characterization had two primary goals; 1) refine risk estimates through the use of less conservative and more realistic assumptions and characterize remaining uncertainty; and 2) identify areas, chemicals, and media contributing most to risk.

Risks Characterized from Aroclor 1254

Aroclor 1254 was detected in several of the biota samples but at concentrations much less than those predicted by generic log K_{ow}-based uptake models. In order to predict Aroclor 1254 concentrations in biota where samples were not available, the ratio of Aroclor 1254 in tissues to those found in sediments were calculated for each tissue type. Bioaccumulation factors ranged from 0.1 for salamander larvae in pond B-1 to 3.3 for fathead minnows in Pond B-4 (Table A7.4).

Risks were first assessed using measured PCB concentrations in fish and invertebrate tissues and were found to be negligible. As an additional step, the ratios of Aroclor 1254 in tissues and sediments were also used to estimate potential risk to the mallard and heron receptors. Protective sediment concentrations were calculated based on exposure models assuming varying degrees of site use. These sediment concentrations, which were termed environmental effects criteria (EECs), varied with the intensity of site use and the complexity of the food chains in each of the ponds. The lowest EECs were based on the highest level of site use and the longest food chains. All EEC calculations were based on organic carbon normalized sediment concentrations and lipid-normalized PCB concentrations in tissues and are presented in Table A7.15.

For mallards, all ponds had PCB concentrations less than the most restrictive EEC which assumed 100% use of that specific pond. This was assumed to indicate that risks to the mallard were low from PCBs.

For longer food chains, the risk evaluation indicated potential risks to the heron in Ponds B-1, B-2 and B-3. Maximum Aroclor 1254 concentrations exceeded the EECs for site use greater than 20 percent in Pond B-2 and 30 percent in Ponds B-1 and B-3. Mean Aroclor 1254 concentrations exceeded the 40 percent site use EEC in Pond B-2, 70 percent in Pond B-1 and 90 percent in Pond B-3.

For shorter food chains (forage fish only) no risks at even maximum concentrations were predicted for either herons or mallards in any pond. Additionally, herons were not expected to be at risk in the most contaminated pond (Pond B-2) unless more than 20 percent of their diet were composed of piscivorous fish from that pond using maximum exposures. Using mean exposures, herons were not predicted to be at risk unless they spent 45 percent of their time feeding exclusively on piscivorous fish at Pond B-2.

Risks Characterized from Mercury

Mercury was identified as a contaminant of concern in the B and C-series ponds was well as the old landfill area. In each area, mercury was included as a contaminant of concern due to measured or estimated concentrations in fish tissues. Mercury was detected in 2 of 13 fish collected in Pond C-1 with an MDC equal to 0.47 mg/kg. Mercury was identified as a contaminant of concern in the old landfill due to fish concentrations calculated from maximum detected concentrations in surface water. Pond sediments in Pond C-1 were assumed to be the likely source of mercury uptake into fish tissues, however, only 15 percent of the fish collected from the pond had detectable levels of mercury indicating some uncertainty in the measurement.

Risks were calculated assuming that herons feed exclusively from Pond C-1 and are exposed to the maximum detected concentrations. This is a highly conservative assumption since Pond C-1 is not large enough to support even one heron feeding exclusively. Considerably lower HQs (HQ = 2) was calculated for the heron in the B-series ponds with the maximum detected concentration coming in Pond B-5.

Risks Characterized from Di-n-butylphthalate

Di-n-butylphthalate was identified as an contaminant of concern in Ponds A-2, A-3 and B-4 based on estimated bioconcentration from surface water. The following evidence was provided that suggests that di-n-butylphthalate may not be a persistent contaminant or represent unacceptable risk in the ponds:

The maximum concentration detected in surface water was 2 ug/L and all of the detectable quantities were estimated below the CRDL of 10 ug/L (all were J qualified).

Di-n-butylphthalate is a hydrophobic compound (log K_{ow} = 4.57) and would likely accumulate in the organic fraction of sediments if it were persistently present. Di-n-butylphthalate was not, however, detected in sediments from those ponds.

Di-n-butylphthalate is a common laboratory contaminant.

The risk estimate was based on an HQ equal to 2 calculated from maximum concentrations in surface water (from Pond A-3). All other detected concentrations were half as much as the MDC (1 ug/L) resulting in HQs equal to 1. Thus, the HQ > 1 was based on only 1 sample with all other HQs being equal to or less than 1.

Risks Characterized from Antimony

Antimony was identified as a contaminant of concern in Woman Creek sediments. A maximum HQ less than 2 was calculated based on 100 percent site use for a heron in the section of Woman Creek in the Old Landfill area. That segment of Woman Creek is seasonally intermittent and only supports a very minimal fish population. Herons have not been documented in that area and it is, therefore, unlikely that sufficient exposure needed to reach the calculated HQ would be possible.

Application to the CRA and Uncertainties

This study documented the potential risk to great blue heron and mallard from ponds and streams of Walnut Creek and Woman Creek. It provides a risk characterization specific to aquatic-feeding birds. This risk characterization was used as a line of evidence for all AEUs in regards to populations and overall ecosystem health. For those EUs that were directly addressed in DOE (1996), comparisons of the concentrations discussed in the risk characterization to current media concentrations can be used to determine if the conclusions reached in DOE (1996) are applicable to current conditions. In all AEUs, including those not directly addressed in DOE (1996), EECs for PCBs can be used as concentrations predictive of risk. For other contaminants of concern, current concentrations can be compared to those used to draw conclusions in the DOE (1996) risk characterization.

The time period in which this study was completed represents an historic condition at RFETS. A significant number of accelerated action efforts, especially in the B-series ponds, have been completed since this time. The flows of water into and out of certain ponds have been altered. Pond C-1 was modified to have a lower depth, the B-series ponds receive less water, and the upper B-series ponds have been remediated by having sediments removed. Therefore, current conditions are likely different from those described in the study.

5.4 Stiger, 1994

OU3 Final RFI/RI – Appendix K. PCB Study: "Results of PCB Sediment and Tissue Sampling For Walnut and Woman Creek Drainages and Offsite Reservoirs – SGS-576-94."

Review

This study was completed in response to preliminary results of sediment and tissue samples collected during the OU 6 RI (August 1992 to June 1993), which indicated elevated PCB concentrations occur for some of the A- and B-series ponds. Because the potential exists for sediment and/or specific biota in Great Western Reservoir and Standley Lake Reservoir to have been impacted by PCB contaminants from RFETS prior to 1989 (prior to the construction of the diversion canal that routes flow coming from Walnut Creek around Great Western Reservoir and back into Walnut Creek below the dam), a sediment and tissue PCB sampling project was undertaken as part of the EE portion of the OU 6 RI.

This effort entailed collecting sediment, fish, and small mammal tissue samples from the A- and B-series ponds to evaluate whether PMJM might be impacted by the presence of PCBs in the RFETS buffer zone. Because PMJM have a diet similar to deer mice, 13 deer mice were collected adjacent to Ponds A-1, A-3, B-1, and B-4 for whole body tissue analysis to evaluate possible PCB contamination in Prebles. In addition, 12 voles were collected from the same locations to determine if they represent a pathway of PCBs to predatory birds, which include voles in their diet.

Results of the deer mice and vole tissue analysis revealed that no PCBs were detected in any of the small mammal tissue samples (whole body) collected from around Ponds A-1, A-3, B-1, and B-4. Comparison to PCB food threshold values for birds revealed that PCB levels in fish do not exceed food concentration threshold values prescribed by DOE (1994). These results suggest that neither the PMJM nor predatory birds are threatened with PCB contamination from RFETS.

Application to the CRA and Uncertainties

This study incorporates several lines of evidence within its design. The sediment and tissue analysis will be used as a line of evidence for NW AEU, SW AUE, and WC AEU with regard to pond bioaccumulation processes. The study evaluated the A-, B-, and C-series ponds specifically for PCB transfer between abiotic (sediment) and biotic (fish tissue) media. The absence of PCB accumulation at concentrations exceeding tissue threshold concentrations in almost all fish at the site indicates that there is a low potential for risk to fish in the pond habitat within NW AEU, SW AEU, WC AEU, and SE AEU.

This study evaluated the potential effects of PCBs in sediment to predatory birds that may feed on organisms that are exposed to PCB-contaminated sediment. This assessment was expanded upon by DOE (1996) and the results of this sampling effort were utilized in that risk assessment. The results of the DOE (1996) study are relied upon to help categorize current risk to waterfowl and wading birds.

The time period in which this study was completed represents an historic condition for RFETS. A significant number of accelerated action efforts have been completed since this time. The sediments from certain ponds (B-1, B-2, and B-3) have been removed, and the food web components that were initially sampled from each pond may no longer be present. Therefore, the study likely represents conservative conditions and over-estimates PCB risks when compared to current conditions at RFETS.

6.0 CHEMICAL LOADING ANALYSES

6.3 DOE, 2004b

RFETS Automated Surface-Water Monitoring. Water Year 2003 Annual Report and Water Year 2004 Source Evaluations for Points of Evaluation GS10, SW027, and SW093. Final.

DOE completes an annual automated surface-water monitoring evaluation as part of the Integrated Monitoring Plan (IMP). The RFETS automated surface-water monitoring network is designed to meet the requirements documented in the Site IMP, which groups all site surface-water monitoring objectives into five primary categories: Sitewide, Industrial Area, Industrial Area Discharges to Ponds, Water Leaving the Site, and Off-Site. The most recent reports for water years 2003 and 2004 were reviewed as lines of evidence for the purpose of describing chemical loading within the AEUs. The methods, conclusions, and application to the CRA for water year 2003 are provided here.

The automated monitoring program is intended to meet a number of objectives. Those that pertain to building lines of evidence for the AEU CRA include the following:

- Monitoring of flows and contaminant levels in subdrainages to allow for the location of contaminant sources;
- Routine monitoring of point-source discharges and reporting of results in compliance with the National Pollutant Discharge Elimination System (NPDES) permit program to control the release of pollutants into the waters of the United States; and
- Detection of statistically significant increases of contaminants in runoff from within the Industrial Area (IA) in general.

The automated program is designed to obtain a loading analysis of constituents of interest. Therefore, the amount of a given chemical is traced through the course of a drainage path, and additional load is identified over distance. This tool helps determine if the drainage is gaining or losing chemical over the course of its path, allowing the identification of source areas as well as chemicals that may be source-related and not a natural phenomenon.

During the water year 2003 effort, the site monitoring network included 62 monitoring locations. The automated network successfully fulfilled the targeted monitoring objectives as required by the Site IMP From the 62 monitoring locations, 441 composite samples composed of 23,455 individual grabs were collected.

Application to the CRA and Uncertainties

Detected metals and radionuclides were evaluated as part of the professional judgment process. The results from this study helped to determine if certain constituents had site-related source areas or demonstrated a pattern of increased or decreased load through the site. The results were constituent- and AEU-specific and are provided in Section 2.0 of Volume 15B1.

The automated surface-water sampling program was developed with specific RFETS objectives in mind, specifically, to evaluate chemical transport within surface water and sediment throughout the site. These objectives do not necessary focus on ecological risk-based concerns. The locations and the hydrologic setting of all the site studies do not necessarily coincide with aquatic ecological habitat settings. Only those chemicals with a point of compliance understanding, or a site source relation, were evaluated further. Chemicals of potential interest from a toxicological standpoint from historic site activities that do not behave in a loading type hydrologic model (i.e., PCBs) were not evaluated. These studies prove useful, yet are limited to the understanding of inorganic and radionuclide chemical spatial extent at RFETS.

7.0 SUMMARY OF FINDINGS

This attachment provides a summary of the methods, results, conclusions, uncertainties, and applications of individual studies conducted within RFETS that provide supporting lines of evidence for the AEU risk characterizations. Numerous studies were available for the larger drainages such as the NW AEU, and few studies were available for smaller drainage components such as the MK AEU. These lines of evidence, coupled with the ECOPC evaluation form the weight-of-evidence risk characterization of the chemical stressors.

The aquatic ecosystems are clearly limited by stressors other than chemicals related to RFETS activities. Habitat quality and quantity are limited, much of the time by inadequate flows. The studies above indicate that some nutrient pollution is and has occurred, which may have affected the aquatic ecology. While chemicals are present in these systems, physical factors such as interrupted flow, stream bank erosion, etc. were cited repeatedly by numerous authors as the primary factors influencing the RFETS aquatic communities Accelerated action activities have been completed since these investigations took place; thus these study results represent a conservative, worse case scenario with respect to chemical contamination.

REFERENCES (check)

Aquatics Associates Inc., 1998. Interim Report: Results of the Aquatic Monitoring Program in Big Dry Creek, 1997. Prepared for the Cities of Broomfield, Northglenn, and Westminster, Colorado.

Aquatics Associates Inc., 2003. Results of the Aquatic Monitoring Program in Streams at the Rocky Flats Site, Golden, Colorado 2001-2002. Prepared for U.S. Department of Energy, Rocky Flats Field Office, Golden, Colorado.

Baxter, R.M., 1977. Environmental effects of dams and impoundments. Ann. Rev. Ecolo. System. 8:255-283 (as cited in DOE, 1996).

Canfield, T.J., N.E. Kemble, W.G. Brumbaugh, F.J. Dwyer, C.G. Ingersoll, and J.F. Fairchild, 1994. Use of benthic invertebrate community structure and the sediment quality triad to evaluate metal-contaminated sediment in the upper Clark Fork River, Montana. Environmental Toxicology and Chemistry, 13(12):1999-2012. (as cited in DOE, 1996).

Chapman, P.M. 1986. Sediment quality criteria from the Sediment Quality Triad: An Example. Environmental Toxicology and Chemistry. 5:957-964. (as cited in DOE, 1996).

Chapman, P.M., E.A. Power, and G.A. Burton, Jr., 1992. Integrative Assessments in Aquatic Ecosystems. In, G.A. Burton, Jr. (ed.) Sediment Toxicity Assessment. Lewis Publishers. Chapter 14, pp 313-340. (as cited in DOE, 1996).

DOE, 1994. Manual for PC-Data Base, Screening Benchmarks for Ecological Risk Assessment (Draft). Prepared for DOE by Environmental Sciences Division, Health Sciences Research Division, Oak Ridge National Laboratory, June.

DOE, 1996. Final Phase I RFI/RI Report. Woman Creek Priority Drainage, Operable Unit 5. Appendix N. Ecological Risk Assessment for Woman Creek and Walnut Creek Watersheds at the Rocky Flats Environmental Technology Site. RF/ER-96-0012. UN. Rev. 0.

DOE, 2004a. Final Comprehensive Risk Assessment Work Plan and Methodology. Rocky Flats Environmental Technology Site, Golden, Colorado. September.

DOE, 2004b. Rocky Flats Environmental Technology Site Automated Surface-Water Monitoring. Water Year 2003 Annual Report and Water Year 2004 Source Evaluations for Points of Evaluation GS10, SW027, and SW093. RF/EMM/WP-04-SWMANLRPT03.UN. Final. December, 2004.

Ebasco Environmental Consultants Inc., 1992. Baseline Biological Characterization of the Terrestrial and Aquatic Habitats at Rocky Flats Plant. Prepared for U.S. DOE, Rocky Flats Field Office. Golden, Colorado.

Eisler, R. 1986. Polychlorinated Biphenyl Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service Biological Report 85 (1.7).

EPA, 1980. Ambient Water Quality Criteria for Polychlorinated Biphenyls. EPA 440/5-80-068, 211p.

EPA, 1992. Sediment Classification Methods Compendium. Sediment Oversight Technical Committee. EPA 823-R-92-006. September (as cited in DOE, 1996).

EPA, 1993. Wildlife Exposure Factors Handbook. Volumes I and II. Office of Research and Development, Washington, D.C. EPA/600/R-93-187a. December.

Exponent, 1998. Final Report: Lower Walnut Creek Aquatic Sampling, Spring 1998. Prepared for Kaiser-Hill Company, LLC, Rocky Flats Environmental Technology Site. Golden, Colorado.

Hoeting, A.L. 1983. FDA Regulation on PCB in Food. Pp 393-407. IN: F.M. D'ltri and M.S. Kamrin (eds) PCBs: Human and Environmental Hazards. Butterworth Publ. Woburn. Massachusetts.

Kaiser-Hill, 1999. 1998 Annual Wildlife Survey for the Rocky Flats Environmental Technology Site. Kaiser-Hill Company, L.L.C., Rocky Flats Environmental Technology Site, Golden, Colorado. (three reports).

Kaiser-Hill, 2000. 1999 Annual Wildlife Survey for the Rocky Flats Environmental Technology Site. Kaiser-Hill Company, L.L.C., Rocky Flats Environmental Technology Site, Golden, Colorado.

Kaiser-Hill, 2001. 2000 Annual Wildlife Survey for the Rocky Flats Environmental Technology Site. Kaiser-Hill Company, L.L.C., Rocky Flats Environmental Technology Site, Golden, Colorado.

MacDonald, C.R., C.D. Metcalf, G.C. Balch, and T.L. Metcalf. 1993. Distribution of PCB Congeners in Seven Lake Systems: Interaction Between Sediment and Food-Web Transport. Environmental Toxicology and Chemistry, 12: 1991-2003.

Nelson, M.K., C.G. Ingersoll, and F.J. Dwyer. 1990. Standard Guide for Conducting Sediment Toxicity Tests with Freshwater Invertebrates. ASTM Committee E-47 on Biological Effects and Environmental Fate, Method E 1383-90. Annual Book of ASTM Standards, Vol. 14.02 (as cited in DOE, 1996).

Power, E.A., and P.M. Chapman, 1992. Assessing Sediment Quality. In G.A. Burton, Jr. (ed.) Sediment Toxicity Assessment. Lewis Publishers. Chapter 1, pp1-16 (as cited in DOE, 1996).

Rasmussen, J.B., D.J. Rowan, D.R.S. Lean, and J.H. Carey, 1990. Food Chain Structure in Ontario Lakes Determines PCB Levels in Lake Trout (Salvelinus namaycush) and Other Pelagic Fish. Canadium Journal of Fisheries and Aquatic Sciences, 47: 2030-2038.

Schnitt, et al., 1983. National Pesticide Monitoring Program: Organochlorine Residues in Freshwater Fish. 1976-79. U.S. Fish Wild. Serv. Resour. 152. 62 p.

Stiger, 1994a. OU 3 Final RFI/RI – Appendix K. PCB Study: "Results of PCB Sediment and Tissue Sampling For Walnut and Woman Creek Drainages and Offsite Reservoirs – SGS-576-94."

Stiger, S.G., 1994b. Memorandum: EG&G Rocky Flats: 94-RF-10997. To: Jessie M. Roberson, Acting Assistant Manager for Environmental

Restoration DOE, RFFO. Attn. Kurt Muenchow. "Results of PCB Sediment and Tissue Sampling for Walnut and Woman Creek Drainages and Offsite Reservoirs – SGS-576-94. From: S.G. Stiger, Director Environmental Restoration Program Division, EG&G Rocky Flats Environmental Technology Site. October 31, 1994.

Ward, J.V., 1992. Aquatic Insect Ecology. John Wiley & Sons, Inc. New York. 438 pp. (as cited in DOE, 1996 and 2004).

Wright Water Engineers, Inc. 2003. Supplemental Biological and Selected Water Quality Data Exploration, 1997-2001. Provided to Big Dry Creek Watershed Association Steering Committee. April 8, 2003.

Wright Water Engineers, Inc., 1994. Integrated Analysis of Habitat, Macroinvertebrate, Fish, Flow and Selected Water Quality Parameters in the Main Stem of Big Dry Creek.

TABLES

Table A7.1
Summary of Other/Drainage Lines of Evidence Available for Each AEU

AEU	Line of Evidence Category and Source				
	Tissue Analysis	**Aquatic Population Studies**	**Bioassay Analysis**	**Waterfowl/Wading Bird Evaluations**	**Chemical Loading Analysis**
NW AEU	Stiger, 1994	Ebasco, 1992	DOE, 1996	Stiger, 1994	DOE, 2004
	DOE, 1996	DOE, 1996	Wolaver et al. 1993	DOE, 1996	
		Exponent, 1998			
		Aquatics Assoc., 1998			
		Kaiser-Hill, 1999, 2000 and 2001			
		Aquatic Assoc., 2003			
		WWE Inc., 2003			
		WWE Inc., 1995			
SW AEU	Stiger, 1994	Ebasco, 1992	DOE, 1996	Stiger, 1994	DOE, 2004
	DOE, 1996	DOE, 1996	Wolaver et al. 1993	DOE, 1996	
		Exponent, 1998			
		Aquatic Assoc., 1998			
		Kaiser-Hill, 1999, 2000 and 2001			
		Aquatic Assoc., 2003			
		WWE Inc., 2003			
		WWE Inc., 1995			
WC AEU	Stiger, 1994	Ebasco, 1992	DOE, 1996	DOE, 1996	DOE, 2004
		DOE, 1996	Wolaver et al. 1993		
		Aquatic Assoc., 1998			
		Kaiser-Hill, 1999, 2000 and 2001			
		Aquatic Assoc., 2003			
		WWE Inc., 1995			
NN AEU	N/A	Ebasco, 1992	N/A	DOE, 1996	DOE, 2004
		DOE, 1996			
		Exponent, 1998			
		Kaiser-Hill, 1999, 2000 and 2001			
RC AEU	N/A	Kaiser-Hill, 1999, 2000 and 2001	N/A	DOE, 1996	DOE, 2004
MK AEU	N/A	Kaiser-Hill, 1999, 2000 and 2001	N/A	DOE, 1996	DOE, 2004
SE AEU	N/A		N/A	DOE, 1996	DOE, 2004

N/A = Not available.

Table A7.2
Unvalidated Sediment Sampling Results (units ug/kg)

A Ponds	Mean* A-1254	Range	Mean A-1248	Range
A 1	75.9	44-88	ND	20
A 2	83.8	20-160	ND	20
A 3	25	20-45	ND	20
A 4	ND	20	ND	20
B 1	868	320-1600	253.6	88-470
B 2	2,073	930-3800	589	20-1500
B 3	572	230-1300	ND	20
B 4	188	120-220	ND	20
B 5	ND	20	ND	20
C 1	ND	20	ND	20
C 2	ND	20	ND	20

(*Calculated using 20 ug/kg, one-half of the instrument detection limits of 40 ug/kg, for nondetects where averaged with detects; n = 5. ND indicates that PCB was not detected in sediment samples of the pond).

Table A7.3
Aroclor-1254 in Aquatic Biota Collected from A- and B-Series Detention Ponds

Pond	Biota Type	Number of Samples	Detection Frequency	Mean[a] (ug/kg)	Standard Deviation1 (ug/kg)
A-1	None	N/A	N/A	N/A	N/A
A-2	Benthic insect	1	1/1	20	N/A
A-2	Crayfish	4	0/4	N/A	N/A
A-2	Largemouth bass	3	3/3	48	9.1
A-3	Crayfish	4	0/4	N/A	N/A
A-4	Crayfish	3	0/3	N/A	N/A
A-4	Fathead minnow	3	3/3	17	5.8
A-5	Crayfish	3	0/3	N/A	N/A
A-5	Fathead minnow	5	3/5	73	41
B-1	Salamander larvae	2	2/2	33	9.9
B-2	Salamander larvae	2	2/2	120	21
B-3	None	N/A	N/A	N/A	N/A
B-4	Fathead minnow	6	3/6	480	17
B-5	Crayfish	3	0/3	N/A	N/A
B-5	Fathead minnow	3	3/3	160	17
C-1	Crayfish	3	0/3	N/A	N/A
C-1	Bluegill	2	2/2	52.5	23.33
C-1	Chub	100	1/1	100	N/A
C-2	Crayfish	2	0/2	N/A	N/A
C-2	Fathead minnow	2	2/2	43	14.14

[a] Mean and standard deviation values were calculated using the values reported for the "real" Aroclor-1254 detections.

N/A = Not applicable.
Source: DOE 1996; Stiger 1994.

Table A7.4
Aroclor-1254 Concentration Ratios in Sediment and Biological Tissues[a]

Pond[b] (species)	Concentration in Sediments		Concentration in Biological Tissues		Aroclor-1254 Concentration Ratios	
	Bulk Sediment (ug/kg)	Organic Carbon (ug/kg C)	Whole Body (ug/kg)	Lipids[c] (ug/kg lipid)	Whole Body/Bulk Sediment	Lipid/Organic Carbon (BSF)
Pond A-2 (largemouth bass)	215	8,270	48	4,800	0.2	0.6
Pond A-2 (benthos)	215	8,270	20	2,000	0.1	0.2
Pond B-1 (tiger salamander)	868	37,700	40	4,000	0.04	0.1
Pond B-2 (tiger salamander)	2,050	89,000	134	13,000	0.1	0.2
Pond B-4 (fathead minnow)	188	14,500	480	48,000	2.6	3.3

[a] Mean for pond.

[b] Data presented only for ponds in which Aroclor-1254 was detected in both sediment and biota.

[c] Assume 1% lipids.

Source: DOE 1996.

Table A7.5
Summary of Community Data from Ebasco 1992

Station	AEU	Type	Location	Phytoplankton Total Taxa	Periphyton Total Taxa	Benthic Invertebrates Total Taxa: Spring 1991	Benthic Invertebrates Total Taxa: Fall 1991	Fish Total Taxa
SWA1	NW	Pond	A1	18	10		24	
SWA2	NW	Pond	A2	5	8			
SWA3	NW	Pond	A3	15	4			
SWA4	NW	Pond	A4	16	22			
SWB1	SW	Pond	B1		21		19	0
SWB2	SW	Pond	B2		18		8	0
SWB3	SW	Pond	B3		24		24	0
SWB4	SW	Pond	B4		25		18	1
SWB5	SW	Pond	B5				3	1
SWO3	SW	Pond	Flume	21	19	9	5	1
WARI1	SW	Stream	Walnut Creek			8		1
SWC1	WC	Pond	C1	48	41	6	10	7
SWC2	WC	Pond	C2	37	60	17	5	1
WOR12	WC	Stream	WC tributary		27	13	14	1
SW107	WC	Stream	WC tributary			15		1
SW39	WC	Stream	WC			18	19	1
SW33	WC	Stream	WC			17	33	2
SW104	WC	Stream	WC tributary			27	30	
WOR13	WC	Stream	WC			29	21	1
WOR11	WC	Stream	WC			25	29	4
SW26	WC	Stream	WC			15		5
WOPO1	WC	Stream	WC			11		2
WOPO2	WC	Stream	WC			6		5

Table A7.6
Pond Benthos Community Structure Summary

Characteristic	Pond A-1	Pond A-2	Pond A-3	Pond A-4	Pond A-5	Pond B-1	Pond B-2	Pond B-3	Pond B-4	Pond B-5	Pond C-1	Pond C-2	Pond D-1	Pond D-2
Total Richness	48	24	27	7	19	36	35	12	20	17	6	18	13	31
Mean Density	25,256.6	10,354.7	30,557.4	8,509.8	4,960.0	17,591.3	11,145.2	55,047.4	32,415.2	26,919.6	66.4	117.6	24,762.9	4,962.0
Simpson's Diversity	0.65	0.43	0.75	0.57	0.19	0.16	0.16	0.84	0.44	0.44	0.44	0.22	0.75	0.1
Shannon-Weiner Diversity	1.07	1.39	0.53	0.81	2.1	2.35	2.22	0.32	1.04	1.16	1.11	1.95	0.51	2.73
Shannon-Weiner Max.[a]	3.87	3.17	3.29	1.94	2.94	3.58	3.55	2.48	2.99	2.83	1.79	2.89	2.56	3.43
Percent Max. Diversity	27.7	43.85	16.11	41.75	71.43	65.64	62.54	12.9	34.78	40.99	62.01	67.47	19.92	79.59
Number Dominant Taxa	2.9	4	1.7	2.2	7.5	10.5	9.2	1.4	2.8	3.2	3	7	1.7	15.4
Dominant Taxa Density	21,917.7	9,120.4	29,790.8	7,951.2	4,544.0	15,863.4	10,172.9	49,538.8	31,388.8	21,592.8	61.6	105.4	24,204.2	4,482.1
% Density Dominant Taxa	86.7	88.1	97.5	93.4	91.6	90.1	91.3	89.9	96.8	80.2	92.7	89.6	97.7	90.3
Oligochaeta Density	20,241.7	1,676.0	26,257.0	6,145.3	1,720.0	5,014.9	194.9	4,586.2	17,455.0	16,837.7	41.6	42.0	21,255.0	39.0
% Density Oligochaeta	80.1	16.2	85.9	72.2	34.6	28.5	1.8	8.3	55.3	62.5	62.6	35.7	85.8	8
Diptera Density	3,167.8	8,367.1	4,066.5	1,974.9	2,552.0	1,232.5	3,339.0	571.7	12,263.6	5,105.9	24.8	68.4	3,422.1	3,001.1
% Density Diptera	12.5	80.8	13.3	23.2	51.4	7	30	1	37.8	19	37.4	58.1	13.8	60.4
Density Weighted TV	5.2	8.9	5.6	6.1	6.9	6.9	8.4	8	7	5.7	6.1	6.9	5.6	8.3
Taxa Mean TV	6.7	7.8	7.5	7.5	7.3	7.8	8	8	7.7	7	7	8	7.5	7.9
Weighted TV Rank	1.0	14	2	6	7	8	13	11	10	4	5	9	3	12

[a] Maximum Shannon-Weiner Diversity based on richness.
TV - Tolerance Valaue
Source: DOE 1996.

Table A7.7
Fish Species Found During Pond Sampling in 1999

Stream Drainage	Sample Location	Common Name
North Walnut Ceeek	Pond A-2	Fathead Minnow
North Walnut Ceeek	Pond A-3	Fathead Minnow
North Walnut Ceeek	Pond A-4	Fathead Minnow
Walnut Creek	Indiana Pond	Fathead Minnow
South Walnut Creek	Pond B-4	Fathead Minnow
South Walnut Creek	Pond B-5	Fathead Minnow
Woman Creek	Pond C-1	Smallmouth Bass
Woman Creek	Pond C-1	Fathead Minnow
Woman Creek	Pond C-1	Creek Chub
Woman Creek	Pond C-2	Fathead Minnow
Smart Ditch	Pond D-1	Fathead Minnow
Smart Ditch	Pond D-2	Fathead Minnow

Source: Kaiser Hill 2000

Table A7.8
Summary of Aquatics Associates Sampling in 2001 and 2002

Location	Habitat Score			Fish taxa and abundance
	Fall 2001	Fall 2002	Summer	2001
WC1	153	153	147	
WC2	130	130	120	
WC3	132	130	130	FHM - 298
WC4 (1)	144	141	n/a	FHM - 2
WC5 (1)	143	147	n/a	FHM - 1
WO1	157	157	147	CC - 11; LND - 1
WO2	158	158	148	CC - 46
WO3	**	**		
WO4	**	**		

** Lack of water precluded assessment

(1) Habitat scores are based on conditions when discharges from terminal ponds occurring; otherwise channel is dry most of the year (total score - 0)
FHM - Fathead minnow
CC - Creek Chub
LND - Longnose dace

Table A7.9
Sediment Bioassay Test Results

Test Media	Sample Date	*Hyalella azteca*							*Chironomus tentans*			
		Control % Survival	Test % Survival	Survival T Statistic	Survival $T_{0.05}$ Value	Control Mean Wt.[a]	Test Mean Wt.	Mean Wt. T Statistic	Control % Survival	Test % Survival	Survival T Statistic	Survival $T_{0.05}$ Value
Pond A-1	10/29/92	74[g]	95	N/A	N/A	0.06	0.11	N/A	N/A[d]	N/A	N/A	N/A
Pond A-2	11/12/92	74[g]	89	N/A	N/A	0.06	0.15	N/A	N/A	N/A	N/A	N/A
Pond A-3	10/21/92	89	76	0.971	2.46	0.13	0.10	N/A	82	103[e]	-2.618[f]	2.46
Pond A-4	10/19/92	89	99	-0.777	2.46	0.13	0.17	N/A	82	73	1.007	2.46
Pond A-5	11/19/92	38g	89	N/A	N/A	0.06	0.33	N/A	N/A	N/A	N/A	N/A
Pond B-1	11/16/92	85	91	-1.094	2.18	0.05	0.16	N/A	N/A	N/A	N/A	N/A
Pond B-2	11/18/92	85	64	3.72[h]	2.18	0.05	0.14	N/A	N/A	N/A	N/A	N/A
Pond B-3	10/27/92	89	84	0.388	2.46	0.13	0.11	N/A	82	88	-0.805	2.46
Pond B-4	10/22/92	89	91	-0.194	2.46	0.13	0.19	N/A	82	62	2.416	2.46
Pond B-5	10/20/92	89	60	2.233	2.46	0.13	0.12	N/A	82	72	1.208	2.46
Pond C-1[b]	11/9/92	74[g]	80	N/A	N/A	0.06	0.14	N/A	N/A	N/A	N/A	N/A
Pond C-1[c]	11/9/92	74[g]	94	N/A	N/A	0.06	0.10	N/A	N/A	N/A	N/A	N/A
Pond C-2	11/10/92	74[g]	96	N/A	N/A	0.06	0.16	N/A	N/A	N/A	N/A	N/A

[a] Mean Weight in grams.

[b] Sediment material from.

[c] Sediment material from

[d] Tests not conducted.

[e] Sample showed evidence of reproduction.

[f] Statistically higher than control; attributed to resident *Chironomus* in test sediments.

[g] Control treatment below acceptable test limit of 80 percent survival.

[h] Statistically lower than control treatment.

N/A = Data not available.

Source: DOE 1996.

Table A7.10

Comparison of Surface Sediment ECOPCs in RFETS Ponds to Contaminant Concentrations in Sediments Used in Toxicity Testing

ECOPC	NOEC ESL	LOEC	Units	Concentrations Measured in Sediments used for Toxicity Testing											Pond A-1		Pond A-2		Pond A-3		Ponc
				Pond A1	Pond A-2	Pond A-3	Pond A-4	Pond B-1	Pond B-2	Pond B-3	Pond B-4	Pond B-5	Pond C-1	Pond C-2	Minimum Detect	Maximum Detect	Minimum Detect	Maximum Detect	Minimum Detect	Maximum Detect	Minimum Detect
Inorganics (mg/kg)																					
Aluminum	15,900	58,000	mg/kg	10300	7480	19900	22900	8330	7850	11990	14550	17900	N/A	12200	11000	25,000	7800	26000	25000	25000	14000
Antimony	2.00	3.20	mg/kg	<21.6	<27.5	<19.9	<37.4	<33.1	<27.4	13.45	17.83	<27.1	0	<12.8	ND	ND	ND	ND	ND	ND	1
Barium	189	287	mg/kg	173	158	172	206	198	157	176.5	193	194	N/A	226	64	220	73	260	200	200	140
Cadmium	0.990	4.98	mg/kg	<1.6	<2	<1.5	3.1	4.8	3.4	4.6	2.55	<2	N/A	<2.8	0	1.30	0	1	0	0	0
Copper	31.6	149	mg/kg	24.7	20.4	24.1	33.4	67.5	<34	66.2	34.3	29.9	N/A	35.9	11	25.0	7	26	25	25	17
Fluoride	0.010	7.00	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	N/A	ND	18	27.00	9	30	24	24	15
Iron	20,000	280,000	mg/kg	17800	13800	22600	22900	13000	15800	14800	20100	21100	N/A	19600	8400	24,000	7700	28000	21000	21000	17000
Lead	35.8	128	mg/kg	39	29.4	26.8	35.9	113	44.4	51.5	47.1	36.8	N/A	34.6	21	29.0	8	33	29	29	18
Manganese	630	1,700	mg/kg	315	323	354	460	218	219	210	326	308	N/A	602	200	500	310	1100	520	520	240
Mercury	0.180	1.06	mg/kg	0.35	<0.12	<0.09	<0.17	0.31	0.47	0.288	0.14	<0.12	N/A	0.68	0	0.180	0	0	0	0	0
Nickel	22.7	48.6	mg/kg	17	28.3	<14.1	<26.4	<23.4	<19.4	28.25	16.45	23.8	N/A	17.1	9	22.0	6	22	20	20	15
Selenium	0.950	1.73	mg/kg	<0.76	<1	<0.72	1.9	<1.2	<0.99	<0.485	<0.38	<0.98	N/A	<1.8	1	1.800	ND	ND	ND	ND	2
Silver	1.00	1.60	mg/kg	<2.3	<3	<2.2	<4.1	124	207	173.5	51.58	<2.9	N/A	<1.9	1	0.81	0	0	ND	ND	ND
Zinc	121	459	mg/kg	93.2	63.9	146	169	314	140	235	248.5	174	N/A	201	55	140	33	110	540	540	66
Organics (ug/kg)																					
2-Methylnaphthalene	20.2	201	ug/kg	<600	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	ND	ND	ND	ND	ND	ND	ND
4-Methylphenol	12.3	670	ug/kg					<1467.5	<820	<390	<315	<780	N/A	<3000	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	4.16	62.9	ug/kg	<29	<37	<28	<48	<46	<39	<18.75	<14.75		N/A	<150	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	6.71	89.0	ug/kg	<600	<770	<590	<990	1274.5	<820	<390	<315	<780	N/A	<3000	ND	ND	180	180	ND	ND	ND
Anthracene	57.2	845	ug/kg	<600	<770	<590	<990	1310	<820	<390	<315	<780	N/A	<3000	ND	ND	210	210	ND	ND	ND
Benzo(a)anthracene	108	1,050	ug/kg	170	<770	<590	<990	785	120	<390	<315	<780	N/A	<3000	73	120	52	52	ND	ND	ND
Benzo(a)pyrene	150	1,450	ug/kg	190	<770	<590	<990	1450	<820	<390	385	<780	N/A	<3000	83	150	51	51	ND	ND	ND
Benzo(g,h,i)perylene	13.0	280	ug/kg	150	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	60	100	ND	ND	ND	ND	ND
Benzo(k)fluoranthene	240	750	ug/kg	110	<770	<590	<990	645	<820	<390	290	<780	N/A	<3000	63	100	ND	ND	ND	ND	ND
Bromomethane	3.43		ug/kg					<76	<25	<61	<19	<24	N/A	<46	ND	ND	ND	ND	ND	ND	ND
Chrysene	166	1,290	ug/kg	220	<770	170	<990	1350	200	405	495	<780	N/A	<3000	82	150	60	60	ND	ND	ND
Dibenz(a,h)anthracene	33.0	240	ug/kg	<600	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	423	2,230	ug/kg	510	<770	360	<990	2900	400	745	1025	190	N/A	<3000	170	300	89	89	ND	ND	ND
Fluorene	77.4	536	ug/kg	<600	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	17.0	250	ug/kg	140	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	50	90	210	210	ND	ND	ND
Naphthalene	176	561	ug/kg	<600	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	ND	ND	ND	ND	ND	ND	ND
PCB-1254	40.0	300	ug/kg	350	<370	<280	<480	3005	6600	2150	625	<370	N/A	<1500	73	88	89	130	45	45	ND
PCB-1260	40.0		ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	N/A	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	204	1,170	ug/kg	300	<770	170	<990	1450	270	400	520	<780	N/A	<3000	87	140	190	190	ND	ND	ND
Pyrene	195	1,520	ug/kg	420	83	290	<990	1750	210	715	910	160	N/A	<3000	ND	ND	ND	ND	ND	ND	ND
Total PAHs	1,610	22,800	ug/kg	4250	5858	4475	7920	23519	5710	7020	7175	<780	N/A	<3000	543	1,330	1106	1106	ND	ND	ND
Total PCBs	40.0	676	ug/kg	495	303.5	280	480	3450	6795	2652.5	772.5	370	N/A	1500	73	88	89	130	45	45	ND

duplicates duplicate values were averaged

< = Value is less than the reported value, less than detection

For duplicate values that were averaged, < indicates both duplicate measures were less than detection at the average of the non detect concentrations

Total PAHs and Total PCBs are summed values for the respective parameters

For Total PAHs and Total PCBs based on duplciate measures, average values for each respective parameter were summed.

For all non detect values that were averaged, 1/2 the detection limit value was used

<NOEC indicates that the parameter was not identified as an ECOPC

Table A7.10
Comparison of Surface Sediment ECOPCs in RFETS Ponds to Contaminant Concentrations in Sediments Used in Toxicity Testing

															A-4
ECOPC	**NOEC ESL**	**LOEC**	**Units**	**Concentrations Measured in Sediments used for Toxicity Testing**											**Maximum Detect**
				Pond A1	**Pond A-2**	**Pond A-3**	**Pond A-4**	**Pond B-1**	**Pond B-2**	**Pond B-3**	**Pond B-4**	**Pond B-5**	**Pond C-1**	**Pond C-2**	
Inorganics (mg/kg)															
Aluminum	15,900	58,000	mg/kg	10300	7480	19900	22900	8330	7850	11990	14550	17900	N/A	12200	26000
Antimony	2.00	3.20	mg/kg	<21.6	<27.5	<19.9	<37.4	<33.1	<27.4	13.45	17.83	<27.1	0	<12.8	41
Barium	189	287	mg/kg	173	158	172	206	198	157	176.5	193	194	N/A	226	206
Cadmium	0.990	4.98	mg/kg	<1.6	<2	<1.5	3.1	4.8	3.4	4.6	2.55	<2	N/A	<2.8	3
Copper	31.6	149	mg/kg	24.7	20.4	24.1	33.4	67.5	<34	66.2	34.3	29.9	N/A	35.9	27
Fluoride	0.010	7.00	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	N/A	ND	33
Iron	20,000	280,000	mg/kg	17800	13800	22600	22900	13000	15800	14800	20100	21100	N/A	19600	22900
Lead	35.8	128	mg/kg	39	29.4	26.8	35.9	113	44.4	51.5	47.1	36.8	N/A	34.6	36
Manganese	630	1,700	mg/kg	315	323	354	460	218	219	210	326	308	N/A	602	460
Mercury	0.180	1.06	mg/kg	0.35	<0.12	<0.09	<0.17	0.31	0.47	0.288	0.14	<0.12	N/A	0.68	0
Nickel	22.7	48.6	mg/kg	17	28.3	<14.1	<26.4	<23.4	<19.4	28.25	16.45	23.8	N/A	17.1	26
Selenium	0.950	1.73	mg/kg	<0.76	<1	<0.72	1.9	<1.2	<0.99	<0.485	<0.38	<0.98	N/A	<1.8	2
Silver	1.00	1.60	mg/kg	<2.3	<3	<2.2	<4.1	124	207	173.5	51.58	<2.9	N/A	<1.9	ND
Zinc	121	459	mg/kg	93.2	63.9	146	169	314	140	235	248.5	174	N/A	201	169
Organics (ug/kg)															
2-Methylnaphthalene	20.2	201	ug/kg	<600	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	ND
4-Methylphenol	12.3	670	ug/kg					<1467.5	<820	<390	<315	<780	N/A	<3000	ND
4,4'-DDT	4.16	62.9	ug/kg	<29	<37	<28	<48	<46	<39	<18.75	<14.75		N/A	<150	ND
Acenaphthene	6.71	89.0	ug/kg	<600	<770	<590	<990	1274.5	<820	<390	<315	<780	N/A	<3000	ND
Anthracene	57.2	845	ug/kg	<600	<770	<590	<990	1310	<820	<390	<315	<780	N/A	<3000	ND
Benzo(a)anthracene	108	1,050	ug/kg	170	<770	<590	<990	785	120	<390	<315	<780	N/A	<3000	ND
Benzo(a)pyrene	150	1,450	ug/kg	190	<770	<590	<990	1450	<820	<390	385	<780	N/A	<3000	ND
Benzo(g,h,i)perylene	13.0	280	ug/kg	150	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	ND
Benzo(k)fluoranthene	240	750	ug/kg	110	<770	<590	<990	645	<820	<390	290	<780	N/A	<3000	ND
Bromomethane	3.43		ug/kg					<76	<25	<61	<19	<24	N/A	<46	ND
Chrysene	166	1,290	ug/kg	220	<770	170	<990	1350	200	405	495	<780	N/A	<3000	ND
Dibenz(a,h)anthracene	33.0	240	ug/kg	<600	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	ND
Fluoranthene	423	2,230	ug/kg	510	<770	360	<990	2900	400	745	1025	190	N/A	<3000	ND
Fluorene	77.4	536	ug/kg	<600	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	ND
Indeno(1,2,3-cd)pyrene	17.0	250	ug/kg	140	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	ND
Naphthalene	176	561	ug/kg	<600	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	ND
PCB-1254	40.0	300	ug/kg	350	<370	<280	<480	3005	6600	2150	625	<370	N/A	<1500	ND
PCB-1260	40.0		ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	N/A	ND	ND
Phenanthrene	204	1,170	ug/kg	300	<770	170	<990	1450	270	400	520	<780	N/A	<3000	ND
Pyrene	195	1,520	ug/kg	420	83	290	<990	1750	210	715	910	160	N/A	<3000	ND
Total PAHs	1,610	22,800	ug/kg	4250	5858	4475	7920	23519	5710	7020	7175	<780	N/A	<3000	ND
Total PCBs	40.0	676	ug/kg	495	303.5	280	480	3450	6795	2652.5	772.5	370	N/A	1500	ND

duplicates duplicate values were averaged
< = Value is less than the reported value, less than detection
For duplicate values that were averaged, < indicates both duplicate measures were less than detection at the average of the non detect concentrations
Total PAHs and Total PCBs are summed values for the respective parameters
For Total PAHs and Total PCBs based on duplciate measures, average values for each respective parameter were summed.
For all non detect values that were averaged, 1/2 the detection limit value was used
<NOEC indicates that the parameter was not identified as an ECOPC

Table A7.10
Comparison of Surface Sediment ECOPCs in RFETS Ponds to Contaminant Concentrations in Sediments Used in Toxicity Testing

ECOPC	NOEC ESL	LOEC	Units	Concentrations Measured in Sediments used for Toxicity Testing											Pond A-5 (Flume Pond)		Pond B-4		Pond B-5		Ponc
				Pond A1	Pond A-2	Pond A-3	Pond A-4	Pond B-1	Pond B-2	Pond B-3	Pond B-4	Pond B-5	Pond C-1	Pond C-2	Minimum Detect	Maximum Detect	Minimum Detect	Maximum Detect	Minimum Detect	Maximum Detect	Minimum Detect
Inorganics (mg/kg)																					
Aluminum	15,900	58,000	mg/kg	10300	7480	19900	22900	8330	7850	11990	14550	17900	N/A	12200	7710	21000	7800	29000	6500	20400	23000
Antimony	2.00	3.20	mg/kg	<21.6	<27.5	<19.9	<37.4	<33.1	<27.4	13.45	17.83	<27.1	0	<12.8	ND	ND	3	3	1	1	1
Barium	189	287	mg/kg	173	158	172	206	198	157	176.5	193	194	N/A	226	120	220	110	220	73	152	250
Cadmium	0.990	4.98	mg/kg	<1.6	<2	<1.5	3.1	4.8	3.4	4.6	2.55	<2	N/A	<2.8	ND	ND	1	2	0	1	1
Copper	31.6	149	mg/kg	24.7	20.4	24.1	33.4	67.5	<34	66.2	34.3	29.9	N/A	35.9	9	21	14	29	8	21	23
Fluoride	0.010	7.00	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	N/A	ND	11	22	13	32	8	22	23
Iron	20,000	280,000	mg/kg	17800	13800	22600	22900	13000	15800	14800	20100	21100	N/A	19600	13000	22000	13000	24000	11000	18800	25000
Lead	35.8	128	mg/kg	39	29.4	26.8	35.9	113	44.4	51.5	47.1	36.8	N/A	34.6	13	21	15	39	10	22	26
Manganese	630	1,700	mg/kg	315	323	354	460	218	219	210	326	308	N/A	602	130	330	110	340	160	317	200
Mercury	0.180	1.06	mg/kg	0.35	<0.12	<0.09	<0.17	0.31	0.47	0.288	0.14	<0.12	N/A	0.68	ND	ND	0	0	0	0	0
Nickel	22.7	48.6	mg/kg	17	28.3	<14.1	<26.4	<23.4	<19.4	28.25	16.45	23.8	N/A	17.1	12	19	9	23	10	20	20
Selenium	0.950	1.73	mg/kg	<0.76	<1	<0.72	1.9	<1.2	<0.99	<0.485	<0.38	<0.98	N/A	<1.8	ND	ND	2	2	1	1	3
Silver	1.00	1.60	mg/kg	<2.3	<3	<2.2	<4.1	124	207	173.5	51.58	<2.9	N/A	<1.9	1	1	2	3	0	0	ND
Zinc	121	459	mg/kg	93.2	63.9	146	169	314	140	235	248.5	174	N/A	201	55	130	130	510	43	120	100
Organics (ug/kg)																					
2-Methylnaphthalene	20.2	201	ug/kg	<600	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	ND	ND	ND	ND	ND	ND	ND
4-Methylphenol	12.3	670	ug/kg					<1467.5	<820	<390	<315	<780	N/A	<3000	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	4.16	62.9	ug/kg	<29	<37	<28	<48	<46	<39	<18.75	<14.75		N/A	<150	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	6.71	89.0	ug/kg	<600	<770	<590	<990	1274.5	<820	<390	<315	<780	N/A	<3000	ND	ND	110	110	ND	ND	74
Anthracene	57.2	845	ug/kg	<600	<770	<590	<990	1310	<820	<390	<315	<780	N/A	<3000	ND	ND	73	140	ND	ND	90
Benzo(a)anthracene	108	1,050	ug/kg	170	<770	<590	<990	785	120	<390	<315	<780	N/A	<3000	ND	ND	80	300	ND	ND	69
Benzo(a)pyrene	150	1,450	ug/kg	190	<770	<590	<990	1450	<820	<390	385	<780	N/A	<3000	ND	ND	100	320	ND	ND	66
Benzo(g,h,i)perylene	13.0	280	ug/kg	150	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	ND	ND	90	270	ND	ND	150
Benzo(k)fluoranthene	240	750	ug/kg	110	<770	<590	<990	645	<820	<390	290	<780	N/A	<3000	ND	ND	270	310	ND	ND	150
Bromomethane	3.43		ug/kg					<76	<25	<61	<19	<24	N/A	<46	ND	ND	ND	ND	ND	ND	ND
Chrysene	166	1,290	ug/kg	220	<770	170	<990	1350	200	405	495	<780	N/A	<3000	ND	ND	74	350	ND	ND	65
Dibenz(a,h)anthracene	33.0	240	ug/kg	<600	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	ND	ND	65	92	ND	ND	530
Fluoranthene	423	2,230	ug/kg	510	<770	360	<990	2900	400	745	1025	190	N/A	<3000	ND	ND	170	750	84	84	120
Fluorene	77.4	536	ug/kg	<600	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	ND	ND	94	94	ND	ND	ND
Indeno(1,2,3-cd)pyrene	17.0	250	ug/kg	140	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	ND	ND	74	200	ND	ND	340
Naphthalene	176	561	ug/kg	<600	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	ND	ND	ND	ND	ND	ND	ND
PCB-1254	40.0	300	ug/kg	350	<370	<280	<480	3005	6600	2150	625	<370	N/A	<1500	ND	ND	120	220	ND	ND	94
PCB-1260	40.0		ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	N/A	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	204	1,170	ug/kg	300	<770	170	<990	1450	270	400	520	<780	N/A	<3000	ND	ND	110	630	ND	ND	310
Pyrene	195	1,520	ug/kg	420	83	290	<990	1750	210	715	910	160	N/A	<3000	ND	ND	580	700	ND	ND	310
Total PAHs	1,610	22,800	ug/kg	4250	5858	4475	7920	23519	5710	7020	7175	<780	N/A	<3000	ND	ND	434	4496	84	84	790
Total PCBs	40.0	676	ug/kg	495	303.5	280	480	3450	6795	2652.5	772.5	370	N/A	1500	ND	ND	120	220	ND	ND	94

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Table A7.10
Comparison of Surface Sediment ECOPCs in RFETS Ponds to Contaminant Concentrations in Sediments Used in Toxicity Testing

ECOPC	NOEC ESL	LOEC	Units	Concentrations Measured in Sediments used for Toxicity Testing											l C-1	Pond C-2	
				Pond A1	Pond A-2	Pond A-3	Pond A-4	Pond B-1	Pond B-2	Pond B-3	Pond B-4	Pond B-5	Pond C-1	Pond C-2	Maximum Detect	Minimum Detect	Maximum Detect
Inorganics (mg/kg)																	
Aluminum	15,900	58,000	mg/kg	10300	7480	19900	22900	8330	7850	11990	14550	17900	N/A	12200	31000	4460	22000
Antimony	2.00	3.20	mg/kg	<21.6	<27.5	<19.9	<37.4	<33.1	<27.4	13.45	17.83	<27.1	0	<12.8	1	ND	ND
Barium	189	287	mg/kg	173	158	172	206	198	157	176.5	193	194	N/A	226	330	74	226
Cadmium	0.990	4.98	mg/kg	<1.6	<2	<1.5	3.1	4.8	3.4	4.6	2.55	<2	N/A	<2.8	1	0	0
Copper	31.6	149	mg/kg	24.7	20.4	24.1	33.4	67.5	<34	66.2	34.3	29.9	N/A	35.9	30	7	25
Fluoride	0.010	7.00	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	N/A	ND	30	9	36
Iron	20,000	280,000	mg/kg	17800	13800	22600	22900	13000	15800	14800	20100	21100	N/A	19600	31000	8090	29000
Lead	35.8	128	mg/kg	39	29.4	26.8	35.9	113	44.4	51.5	47.1	36.8	N/A	34.6	38	11	35
Manganese	630	1,700	mg/kg	315	323	354	460	218	219	210	326	308	N/A	602	970	260	602
Mercury	0.180	1.06	mg/kg	0.35	<0.12	<0.09	<0.17	0.31	0.47	0.288	0.14	<0.12	N/A	0.68	0	0	1
Nickel	22.7	48.6	mg/kg	17	28.3	<14.1	<26.4	<23.4	<19.4	28.25	16.45	23.8	N/A	17.1	24	5	21
Selenium	0.950	1.73	mg/kg	<0.76	<1	<0.72	1.9	<1.2	<0.99	<0.485	<0.38	<0.98	N/A	<1.8	3	1	1
Silver	1.00	1.60	mg/kg	<2.3	<3	<2.2	<4.1	124	207	173.5	51.58	<2.9	N/A	<1.9	ND	ND	ND
Zinc	121	459	mg/kg	93.2	63.9	146	169	314	140	235	248.5	174	N/A	201	140	45	201
Organics (ug/kg)																	
2-Methylnaphthalene	20.2	201	ug/kg	<600	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	ND	ND	ND
4-Methylphenol	12.3	670	ug/kg					<1467.5	<820	<390	<315	<780	N/A	<3000	ND	ND	ND
4,4'-DDT	4.16	62.9	ug/kg	<29	<37	<28	<48	<46	<39	<18.75	<14.75		N/A	<150	ND	ND	ND
Acenaphthene	6.71	89.0	ug/kg	<600	<770	<590	<990	1274.5	<820	<390	<315	<780	N/A	<3000	320	ND	ND
Anthracene	57.2	845	ug/kg	<600	<770	<590	<990	1310	<820	<390	<315	<780	N/A	<3000	450	ND	ND
Benzo(a)anthracene	108	1,050	ug/kg	170	<770	<590	<990	785	120	<390	<315	<780	N/A	<3000	190	ND	ND
Benzo(a)pyrene	150	1,450	ug/kg	190	<770	<590	<990	1450	<820	<390	385	<780	N/A	<3000	170	ND	ND
Benzo(g,h,i)perylene	13.0	280	ug/kg	150	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	150	ND	ND
Benzo(k)fluoranthene	240	750	ug/kg	110	<770	<590	<990	645	<820	<390	290	<780	N/A	<3000	150	ND	ND
Bromomethane	3.43		ug/kg					<76	<25	<61	<19	<24	N/A	<46	ND	ND	ND
Chrysene	166	1,290	ug/kg	220	<770	170	<990	1350	200	405	495	<780	N/A	<3000	190	ND	ND
Dibenz(a,h)anthracene	33.0	240	ug/kg	<600	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	530	ND	ND
Fluoranthene	423	2,230	ug/kg	510	<770	360	<990	2900	400	745	1025	190	N/A	<3000	330	140	140
Fluorene	77.4	536	ug/kg	<600	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	ND	ND	ND
Indeno(1,2,3-cd)pyrene	17.0	250	ug/kg	140	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	500	ND	ND
Naphthalene	176	561	ug/kg	<600	<770	<590	<990	<1467.5	<820	<390	<315	<780	N/A	<3000	ND	ND	ND
PCB-1254	40.0	300	ug/kg	350	<370	<280	<480	3005	6600	2150	625	<370	N/A	<1500	94	ND	ND
PCB-1260	40.0		ug/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	N/A	ND	ND	ND	ND
Phenanthrene	204	1,170	ug/kg	300	<770	170	<990	1450	270	400	520	<780	N/A	<3000	360	ND	ND
Pyrene	195	1,520	ug/kg	420	83	290	<990	1750	210	715	910	160	N/A	<3000	310	ND	ND
Total PAHs	1,610	22,800	ug/kg	4250	5858	4475	7920	23519	5710	7020	7175	<780	N/A	<3000	2950	140	140
Total PCBs	40.0	676	ug/kg	495	303.5	280	480	3450	6795	2652.5	772.5	370	N/A	1500	94	ND	ND

duplicates — duplicate values were averaged
< = Value is less than the reported value, less than detection
For duplicate values that were averaged, < indicates both duplicate measures were less than detection at the average of the non detect concentrations
Total PAHs and Total PCBs are summed values for the respective parameters
For Total PAHs and Total PCBs based on duplciate measures, average values for each respective parameter were summed.
For all non detect values that were averaged, 1/2 the detection limit value was used
<NOEC indicates that the parameter was not identified as an ECOPC

Table A7.11
Exposure Parameters for Heron and Mallard (DOE, 1996)

Receptor	Total Ingestion Rate (kg/kg BW/day)	Intake Rate (kg/kg BW/day)				
		Fish	Benthic Macroinvertebrate	Vegetation	Sediment	Surface Water
Great Blue Heron	0.18	0.18 (100%)	0	0	0.004	0.045
Mallard	0.052	0	0.039 (75%)	0.013 (25%)	0.001	0.056

Ingestion Rates Taken From DOE (1996).

Table A7.12

Source Area Hazard Index for Mallard and Great Blue Heron

Source Area	Watershed	Mallard HI	GB Heron HI
OU6 A-Ponds	Walnut	4.55	23.5
OU6 B-Ponds	Walnut	1.61	18.7
OU2 903 Pad	Walnut/Woman	0.5	7.84
OU5 C-Ponds	Woman	1.65	17.19
OU1 881 Hillside	Woman	0.26	8.91
OU5 Old Landfill	Woman	0.7	41.23
OU5 Ash Pits	Woman	0.04	8.05

Based on screening-level risk estimates.

Table A7.13
Screening-Level Hazard Quotients Contributing to Initial Risk Estimates to Heron

Source Area	ECOC	GB Heron HQ (% of HI)	Prey Est. Value Intake (mg/kg)	Sediment Concentration (mg/kg)	Total Intake Concentration[a] (mg/kg)
OU6 A-Ponds	DBP	16.56 (70.45%)	0.744	ND	0.745
OU6 B-Ponds	DBP	8.27 (44.21%)	0.372	ND	0.372
OU6 B-Ponds	Hg	2.40 (12.83%)	0.0110	0.00100	0.0120
OU2 903 Pad	Aroclor-1254	5.78 (73.66%)	0.780	0	0.780
OU5 C-Ponds	Hg	6.40 (37.24%)	0.0310	0.00200	0.0320
OU1 881 Hillside	Mg	1.95 (21.95%)	No BCF	22.7	23.3
OU5 Old Landfill	Hg	28.80 (69.85%)	0.132	0.0130	0.144
OU5 Ash Pits	Cd	2.98 (37.03%)	3.47	0.00500	3.47

[a] Total intake may be larger due to surface water contaminant intake, usually small portion.
ND = Not detected in laboratory samples.
Only presents those HQs that were greater than 1 in the screening-level risk assessment.

Table A7.14
Screening-Level Hazard Quotients Contributing to Initial Risk Estimates to Mallard

Source Area	ECOC	Mallard HQ (% of HI)	Prey Est. Value Intake (mg/kg)	Sediment Concentration (mg/kg)	Total Intake Concentration[a] (mg/kg)
OU6 A-Ponds	DBP	2.00 (43.92%)	0.114	ND	0.114
OU6 B-Ponds	DBP	0.47 (29.66%)	0.027	ND	0.027
OU6 B-Ponds	Hg	0.25 (15.65%)	0.006	6.93E-05	0.006
OU2 903 Pad	Aroclor-1254	0.31 (61.27%)	0.053	3.64E-06	0.053
OU5 C-Ponds	Zn	1.00 (53.90%)	2.613	0.016	2.718
OU1 881 Hillside	Phenanthrene	0.06 (21.33%)	ND	6.08E-06	0.002
OU5 Old Landfill	Zn	0.26 (37.27%)	0.692	0.051	0.791
OU5 Ash Pits	Al	0.01 (21.67%)	0.005	0.06	0.533

[a] Total intake may be larger due to vegetation, soil or surface water contaminant intake, usually small portion.
ND = Not detected in laboratory samples.
Only presents those HQs that were greater than 1 in the screening-level risk assessment.

Table A7.15
Aroclor 1254 Sediment Concentrations Representative of NOAEL-Based HQs Equal to 1.

Species	Trophic Levels Present	EEC[1] (mg/kg carbon)	Site Use Factor	TRV Used[2] (mg/kg BW day)
Mallard	Forage Fish Present	1230	0.1	0.17
		613	0.2	0.17
		409	0.3	0.17
		307	0.4	0.17
		245	0.5	0.17
		204	0.6	0.17
		175	0.7	0.17
		153	0.8	0.17
		136	0.9	0.17
		123	1	0.17
Heron	Forage Fish Present	1070	0.1	0.17
		537	0.2	0.17
		358	0.3	0.17
		268	0.4	0.17
		215	0.5	0.17
		179	0.6	0.17
		153	0.7	0.17
		134	0.8	0.17
		119	0.9	0.17
		107	1	0.17
Heron	Forage Fish	221	0.1	0.14
	and Aquatic Predators	111	0.2	0.14
	Present	73.8	0.3	0.14
		55.3	0.4	0.14
		44.3	0.5	0.14
		36.9	0.6	0.14
		31.6	0.7	0.14
		27.7	0.8	0.14
		24.6	0.9	0.14
		22.1	1	0.14

Full details are provided on Table N5-10 of DOE (1996)

[1] EECs are representative of sediment concentrations resulting in HQs = 1 using the TRVs provided.
- Maximum Biota to sediment transfer factors from site-specific data used.
- EECs are presented in mg PCB/kg carbon
- 1% lipid content in fish tissues is assumed,

[2] TRVs are NOAEL TRVs. The CRA Methodology NOAEL is 0.09 mg/kg BW/day.
The CRA Methodology LOAEL is 1.27 mg/kg BW/day.